



## The Digital Evolution of the Research Ecosystem: A Strategic Analysis of Ankara University's Research Capacity and Performance via Collaborative Networks

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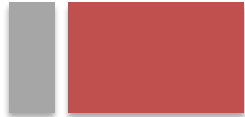
### Abstract

Understanding how collaboration networks and digital infrastructures shape institutional research capacity has become a central concern in higher education research. Universities increasingly rely on integrated digital systems to enhance academic productivity, international visibility, and research performance within competitive global environments. In this context, the research capacity of Ankara University is examined through a multi-dimensional analytical framework incorporating collaboration platforms, bibliometric evaluation tools, laboratory management systems, and academic writing support mechanisms. Drawing on a descriptive and data-driven analytical approach, the study evaluates institutional performance using indicators related to publication output, citation impact, collaboration patterns, research infrastructure utilization, and project participation. The findings reveal a consistent increase in research performance, reflected in higher publication visibility, improved citation metrics, and expanded engagement in national and international funding programs. At the same time, the results indicate uneven adoption of digital systems and significant variation in research capacity across disciplines and academic units. The analysis further demonstrates that digital research infrastructures contribute to improved coordination, access to collaboration opportunities, and output quality; however, their effectiveness depends on institutional integration and user engagement. Structural constraints, including disparities in human resources and limited industry collaboration, continue to shape research outcomes and highlight gaps between knowledge production and its practical application. Overall, the findings suggest that strengthening institutional research capacity requires a holistic strategy that integrates technological systems, organizational practices, and collaboration networks. Enhancing user engagement, supporting balanced capacity development across academic units, and fostering stronger links between academia and industry are essential for achieving sustainable improvements in research performance and global competitiveness.

**Keywords:** *Research Capacity, Collaboration Networks, Academic Productivity, Digital Tools, Strategic Development*

### Introduction

The research capacity of universities is now evaluated not solely through individual academic productivity, but also through the quality of collaboration networks among researchers, the effectiveness of digital research infrastructures, and the sustainability of institutional research ecosystems. The acceleration of digitalization, the increasingly data-driven nature of research processes, and the transformation of scientific problems into an interdisciplinary structure have moved higher education institutions away from the traditional individual research model and positioned network-based, collaborative research structures at the center of academic activity. Wuchty et al. (2007) and Abbasi et al. (2011) demonstrated that collaboration networks play a decisive role in research performance when solving large-scale research problems, while Petersen (2015) emphasized that a researcher's central position within a network enhances visibility and citation impact. Similarly, Hsieh et al. (2018) noted that collaboration networks strengthen academic productivity not only through direct partnerships but also through indirect connections within the network. With the proliferation of digital research platforms in recent years, research ecosystems have begun to be reshaped through interactions among researchers, universities, technological infrastructures, and data management systems (Neborsky, 2021; Zakirova, 2022). However, a significant portion of the existing literature focuses either on



global-scale research networks or on Western-centric university systems, leaving the structural and strategic dynamics of digital research ecosystems in large public universities in developing countries underexplored. This situation necessitates a holistic analysis of the research capacity of established and comprehensive higher education institutions such as Ankara University within the context of collaboration networks and digital transformation.

### **The Paradigm Shift from Individual Scholarship to Networked Science**

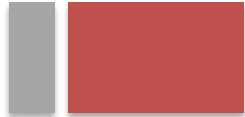
A growing body of literature demonstrates that research performance is not solely an individual attribute but is profoundly shaped by structural, relational, and contextual factors. The shift towards big team science, the escalating complexity of contemporary research questions, and the substantial costs of advanced scientific infrastructure have rendered collaboration not merely beneficial but essential (Wuchty et al., 2007; Abbasi et al., 2011). As analysis of global academic systems becomes more sophisticated, collaboration networks function as essential analytical constructs for examining knowledge flow and the distribution of reputational advantage. The influence of these networks begins at the level of the individual researcher, where structural configuration significantly impacts publication visibility and citation performance. In this regard, Petersen (2015) introduced the concept of network-mediated reputation overflow, demonstrating that a researcher's centrality within a network facilitates increased citation impact. This enhanced visibility occurs through both direct association with influential collaborators and embeddedness within productive networks. Similarly, Abbasi et al. (2011) used correlation and regression analyses to demonstrate that co-authorship networks significantly affect productivity, particularly through the roles played by advisors and professional peers. Hsieh et al. (2018) further emphasized the presence of spillover effects, where the benefits of collaboration extend beyond direct partnerships to indirectly benefit all members within a connected cluster. Consequently, academic performance is not determined exclusively by individual merit but is co-constructed within interconnected, relational environments.

### **The Strategic Balance Between Local and International Collaborations**

The strategic value of a university's collaborative portfolio depends critically on the balance between local and international partnerships. Local clusters can foster dense, trust-based relationships efficient for knowledge sharing, yet evidence suggests they may also lead to intellectual lock-in and reduced novelty. International collaborations, while more costly to coordinate, provide access to diverse knowledge bases, cutting-edge methodologies, and prestigious funding streams. In a detailed analysis of Indian biotechnology research, Mondal et al. (2021) found a predominance of local collaboration networks but simultaneously emphasized the necessity of expanding international ties to strengthen long-term scientific capacity. Complementing this view, Wang and Zhang (2019) argued that the impact of international collaborations on research quality can vary significantly across disciplines, suggesting that a one-size-fits-all strategy is ineffective. These findings collectively lead to a nuanced conclusion for an institution like Ankara University: it is not merely the extent of collaboration that matters, but the qualitative diversity of its overall collaborative portfolio.

### **Organizational, Socio-Psychological, and Technological Dynamics**

Beyond structural positioning, research has moved toward understanding networks as lived, relational environments where socio-psychological dynamics exert measurable influence. Individuals occupying central positions within social networks tend to achieve higher academic outcomes, partly due to stronger emotional ties, trust, and reciprocity. Marqués-Sánchez et al. (2020) demonstrated that these relational dimensions introduce critical factors often overlooked in purely quantitative assessments of research capacity. The role of digital technologies in facilitating these dynamics has become increasingly prominent, as the COVID-19 pandemic radically altered collaboration patterns by forcing a rapid reliance on digital platforms. This global disruption accelerated the transition toward digitally mediated research ecosystems, where technological infrastructures play a central role in enabling sustained academic interaction and productivity (Damaševičius, 2023). From a policy perspective, international frameworks increasingly promote collaborative research as a



means to address complex scientific challenges, underscoring institutional responsibility to provide supportive environments including adequate funding and robust digital infrastructure (Toney & Flagg, 2021). Therefore, the development of collaboration networks must be a strategic priority, not an incidental outcome, for any university aiming to improve its global standing.

### **A Holistic, Network-Oriented Strategic Analysis**

A critical gap remains despite the robust evidence correlating collaboration with performance. Most existing studies examine these dynamics at a global or disciplinary level, or within the context of well-established research universities in Western Europe and North America. There is a pressing need for in-depth, institution-specific strategic analyses that examine how these abstract network principles manifest in complex, resource-constrained environments, particularly in emerging economies. The concept of the digital ecosystem provides a valuable analytical framework for addressing this gap. As a digital counterpart to biological ecosystems, a university's digital ecosystem consists of multiple independent entities including individuals, organizations, services, and software that perform interrelated tasks focused on interaction and connectivity (Zakirova, 2022). Neborsky (2021) further structures this ecosystem into seven core components: digital environment including technical infrastructure, interaction participants or stakeholders, the system of connections between participants, participant engagement, digitally reflected university functions, ideas and values regarding digital technologies, and digital productivity and adequacy. When applied to research capacity, this framework reveals that performance cannot be reduced to individual productivity or physical infrastructure alone. Instead, research capacity depends on the quality of interaction among multiple actors including researchers, administrative units, technology parks, partner universities, and industry collaborators.

The effectiveness of digital platforms facilitating this interaction, the level of stakeholder commitment to digital processes, and the institution's data-driven decision-making mechanisms all play determinative roles (Rosak-Szyrocka, 2024; Zhao & Yang, 2024). The digital transformation of research ecosystems has been further accelerated by the emergence of advanced professional services. Research activities are becoming increasingly systematic and data-driven through digital software and platforms that support data collection, visualization, statistical analysis, and manuscript writing (Brunetti et al., 2023). While these tools significantly enhance measurable productivity and quality, they also introduce the risk of mass science, where standardized, algorithm-driven outputs may constrain scientific creativity and originality. Consequently, institutions must maintain a delicate strategic balance between technological automation and the preservation of genuine intellectual innovation.

The specific challenges facing universities in this transformation are multifaceted. Deficiencies in technological infrastructure, budget constraints, lack of strategic planning, and organizational misalignment constitute six major categories of barriers. From a human resource perspective, academic staff often exhibit fear of abandoning existing pedagogical habits and concerns about job security, creating powerful cultural barriers (Aditya et al., 2021). These obstacles are further complicated by regional disparities in hardware availability and insufficient coordination with external stakeholders. In this context, digital leadership emerges as a critical success factor. A growing body of research indicates that digital leaders play a vital role in building a digital culture, breaking resistance to change, and establishing a collaborative climate, going far beyond merely managing technological innovations (Onan, 2024; Anwar & Sarah, 2024). It has been widely acknowledged that without this leadership dimension, technological investments are unlikely to yield expected returns when institutional culture and human factors are neglected (Neborsky, 2021). These findings collectively suggest that successful digital transformation in higher education depends on both technical and human-centered leadership strategies.

The future evolution of higher education points toward University 5.0, a concept that moves beyond merely responding to Industry 4.0 dynamics. This new model centers on collective well-being and emotional intelligence, integrating open-source platforms and low-tech, environmentally friendly solutions as alternatives to capitalist data monopolies (Rosak-Szyrocka, 2024; Fitzpatrick et al., 2025). The philosophical challenge for universities is to build a smart education model that respects the planet's ecological limits while



upholding human dignity. Within this broader context, collaborative networks function as the operational infrastructure through which research capacity is built, sustained, and enhanced. However, institutional transformation of this magnitude requires more than technological investment; it demands strategic leadership, digital maturity, cultural change, and continuous learning. The interaction among multiple actors across university, industry, and government sectors must be elevated in quality, supported by effective digital platforms, and managed through strategic network positioning.

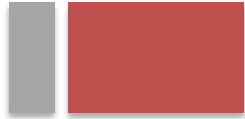
Given these theoretical and empirical considerations, the analysis of research capacity and the impact of collaboration networks on academic performance has emerged as a critical and increasingly complex domain within contemporary higher education research. The interaction between collaboration networks and academic output constitutes a foundational dimension for explaining how researchers and institutions can strategically enhance their visibility, impact, and overall research effectiveness. The present body of literature provides a comprehensive framework for interpreting how both structural and relational aspects of collaboration networks shape academic outcomes. Collaboration networks function as essential analytical constructs for examining the dynamics of academic productivity, offering insights into how knowledge flows, reputational advantages, and resource accessibility are distributed across scientific communities. The structural configuration of these networks significantly influences publication visibility and citation performance, yet the role of digitally mediated research management tools, the relative contribution of different network dimensions, and the specific institutional challenges facing large comprehensive universities remain underexplored.

### **Research Purpose and Questions**

In light of the theoretical and empirical considerations outlined above, this study aims to address this gap by conducting a strategic analysis of a specific institution: Ankara University. The primary purpose of this research is to investigate the digital evolution of Ankara University's research ecosystem by analyzing the influence of its collaborative networks on its overall research capacity and academic performance. The study seeks to move beyond simple bibliometric counts to understand how structural, relational, and technological dimensions of collaboration interact to shape the university's scholarly output and international competitiveness.

To achieve this purpose and to provide a structured framework for investigation, the study is guided by the following research questions:

1. How do collaboration networks influence the research capacity and academic performance of Ankara University?
2. What is the role of digitally mediated research management tools in shaping collaboration patterns and research outputs?
3. To what extent do the structural, relational, and technological dimensions of collaboration networks contribute to institutional research performance?
4. What are the key challenges and limitations affecting the effective utilization of collaboration networks within the institutional context of Ankara University?
5. What strategic interventions can be developed to enhance sustainable research capacity and international competitiveness through collaboration networks?



## Method

### *Research Design*

This study employed a convergent parallel mixed-methods design (Creswell & Plano Clark, 2018), in which quantitative and qualitative data were collected concurrently, analyzed separately, and subsequently integrated during the interpretation phase. This design was selected to capture both the measurable dimensions of institutional research capacity (e.g., publication metrics, system usage rates) and the experiential, contextual factors (e.g., user perceptions, barriers, facilitators) that shape the effectiveness of digital research infrastructures.

Quantitative data were obtained from four primary sources: (a) SCIVAL bibliometric database, (b) LABSIS virtual laboratory management system, (c) Crowdhelix collaboration platform usage logs, and (d) institutional performance databases (TÜBİTAK project records, publication archives). Qualitative data were collected through semi-structured interviews (n = 12), one focus group discussion (n = 8), open-ended survey questions (n = 70), and document analysis (n = 17 documents). Integration of the two data strands was achieved using a joint display matrix (Guetterman et al., 2015), which allowed systematic comparison, identification of convergence/divergence, and generation of meta-inferences.

### **Materials and Data Collection Instruments**

#### *Quantitative Data Sources*

*SCIVAL (Elsevier).* SCIVAL was used to retrieve Scopus-indexed publication data for Ankara University over a five-year period (2019–2023). Key performance indicators included Field-Weighted Citation Impact (FWCI), h-index, publication volume, and collaboration metrics (national vs. international co-authorships). Benchmarking analyses compared the university's performance with national and international peer institutions.

*LABSIS.* The LABSIS system provided automated logs on laboratory device usage, reservation frequency, user demographics (n = 169 unique users), equipment status, and financial tracking data across 10 registered laboratories and 276 devices.

*Crowdhelix Platform.* Crowdhelix usage metrics included number of registered users (n = 263), number of partner search announcements disseminated (n = 11), project applications submitted (n = 6), and partnership declarations (n = 6).

*Institutional Databases.* TÜBİTAK project records and postgraduate thesis completion data (n = 4,887 theses over five years) were obtained from Ankara University's Research Projects Support Office and Graduate School archives.

#### *Qualitative Data Collection Instruments*

*Semi-Structured Interview Protocol (Crowdhelix).* An interview guide was developed based on the theoretical framework of network-mediated reputation overflow (Petersen, 2015) and technology acceptance models (Davis, 1989). The guide included 12 open-ended questions exploring perceived barriers, facilitators, platform utility, and the role of digital collaboration tools in forming international research partnerships. Interviews lasted 35–50 minutes and were conducted via video conferencing.

*Focus Group Protocol (LABSIS).* A semi-structured focus group guide was designed to evaluate LABSIS usability, effect on collaborative workflows, and user satisfaction. The guide included six prompt questions addressing system strengths, limitations, training adequacy, and suggestions for improvement. The session lasted 90 minutes and was moderated by a researcher not involved in system administration.

*Open-Ended Questionnaire (TRADOS Writing Support).* A web-based questionnaire (Google Forms) was distributed to 70 researchers who had received language compliance certificates from the Scientific Writing and Article Support Unit. The questionnaire contained two core open-ended questions: (a) “How did the language support system affect your manuscript submission process?” and (b) “What improvements would you suggest?” Demographic information (faculty, academic position, number of submissions) was also collected.

*Document Analysis Materials.* Seventeen documents were analyzed, comprising 11 Horizon Europe partner search announcements and 6 partnership declarations submitted via CrowdHelix. These documents were examined to identify strategic collaboration priorities, thematic focus areas, and the nature of proposed partnerships.

#### *Procedure*

Data collection and analysis followed a concurrent timeline over a six-month period (January–June 2023).

*Quantitative Data Collection.* SCIVAL data were extracted using institutional subscription credentials, applying filters for Ankara University-affiliated publications (2019–2023). LABSIS and CrowdHelix logs were exported as CSV files from system dashboards. Institutional databases were accessed through the Rectorate’s Research Coordination Unit, with anonymized aggregate data provided for analysis.

*Qualitative Data Collection.* Semi-structured interviews (n = 12) were conducted with CrowdHelix users selected via maximum variation sampling based on publication performance (high/low FWCI) and platform engagement level (active/low). Participants were recruited through institutional email invitations. All interviews were audio-recorded with informed consent. The focus group (n = 8) included four principal investigators, two laboratory managers, and two PhD students who had used LABSIS for at least three months. The open-ended questionnaire was distributed via institutional email to all 70 researchers who had received a language compliance certificate in the preceding 12 months; 54 completed responses were returned (response rate: 77.1%). Document analysis was performed on publicly available partner search announcements archived within the CrowdHelix platform.

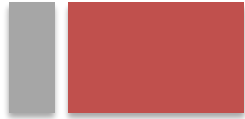
## **Data Analysis**

### *Quantitative Data Analysis*

Quantitative data were analyzed using descriptive statistics (frequencies, percentages, means) and comparative metrics (FWCI, h-index). SCIVAL data were processed using the platform’s built-in analytical modules. LABSIS and CrowdHelix logs were analyzed using Microsoft Excel and SPSS (version 26). Institutional publication and project data were analyzed to calculate publication conversion rates (thesis-to-publication ratio: 26.35%). Simulation-based ranking predictions were performed using linear regression to assess predictive validity.

### *Qualitative Data Analysis*

*Thematic Analysis (Interviews & Focus Group).* Interview and focus group transcripts were analyzed using inductive thematic analysis (Braun & Clarke, 2006) with NVivo (version 14). The analysis followed six phases: (a) familiarization with data, (b) generating initial codes, (c) searching for themes, (d) reviewing themes, (e) defining and naming themes, and (f) producing the report. Two researchers independently coded 20% of the transcripts to calculate inter-coder reliability (Cohen’s  $\kappa = 0.84$ ), indicating strong agreement.



*Content Analysis (Open-Ended Questionnaire).* Responses to open-ended questions were analyzed using conventional content analysis (Hsieh & Shannon, 2005). Two coders independently identified meaning units, condensed them, and assigned codes. Codes were then grouped into categories, and categories were abstracted into themes. Disagreements were resolved through consensus.

*Document Analysis.* The 17 partnership documents were analyzed using directed content analysis (Hsieh & Shannon, 2005), guided by predefined categories derived from the Horizon Europe work program themes (e.g., Cluster 6, Cancer Mission, Water4All, Sustainable Blue Economy). Each document was coded for thematic focus, partner types, and stated collaboration objectives.

*Mixed-Methods Integration*

Integration of quantitative and qualitative findings was achieved through a joint display matrix (Guetterman et al., 2015). Quantitative indicators (e.g., publication counts, FWCI, system usage rates) were placed alongside corresponding qualitative themes (e.g., user-perceived barriers, facilitators). The matrix allowed systematic comparison to identify:

- *Convergence:* where both data types supported the same conclusion;
- *Divergence:* where findings contradicted or complemented each other;
- *Complementarity:* where each data type provided unique insights into different aspects of the same phenomenon.

Meta-inferences were then generated by interpreting the integrated results within the theoretical framework of collaboration networks and digital research infrastructure.

**Results**

The findings of this study are organized according to the five research questions that guided the convergent parallel mixed-methods design. Quantitative findings from SCIVAL, LABSIS, Crowdhelix, and institutional databases are presented alongside qualitative themes derived from semi-structured interviews (n=12), focus group (n=8), open-ended questionnaires (n=70), and document analysis (n=17). Integration of quantitative and qualitative strands is presented through joint display matrices to identify convergence, divergence, and complementarity across data sources.

**Research Question 1: How do collaboration networks influence the research capacity and academic performance of Ankara University?**

*Quantitative Findings*

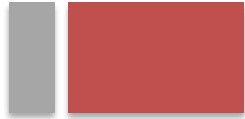
Findings related to Crowdhelix platform adoption and international collaboration network engagement are presented below in Table 1.

**Table 1**

*Crowdhelix Platform Usage and International Collaboration Indicators*

Indicator	Value
Registered users (institutional email)	263
Partner search announcements disseminated	11
Completed project outcomes shared	1

Table 1 continue...



Indicator	Value
Horizon Europe Cluster 6 applications	1
Horizon Europe Cancer Mission applications	1
Strengthening ERA initiative applications	1
European Partnership applications (Water4All, SBEP)	2
Partnership declarations submitted	6

As shown in Table 1, a total of 263 researchers from Ankara University registered on the CrowdHelix platform using institutional email addresses. This number indicates a moderate level of initial adoption within the academic community. However, only 11 partner search announcements were disseminated and only 6 partnership declarations were submitted. This finding suggests that active platform utilization for collaboration purposes remains limited relative to the number of registered users. Specifically, while 263 individuals created accounts, the average number of collaboration actions per user was 0.07, indicating that registration alone does not translate into active engagement. Furthermore, five project applications were submitted across various Horizon Europe calls, all of which remained under consortium-level evaluation at the time of analysis. These quantitative indicators suggest that while the platform successfully lowered the barrier to initial registration, it has not yet been fully integrated into researchers' regular collaboration workflows.

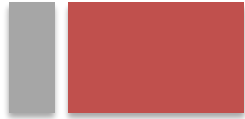
Findings related to SCIVAL-based bibliometric indicators of institutional research performance over a five-year period are presented below in Table 2.

**Table 2**

*Five-Year Research Performance Indicators (2019–2023)*

Indicator	Value
Total postgraduate theses completed	4,887
Publication conversion rate (thesis to publication)	26.35%
TÜBİTAK 1001 project ranking (2023) – Overall	3rd
TÜBİTAK 1001 project ranking (2023) – State universities	2nd
Predicted ranking range (simulation)	11–13
Actual ranking	9th

As presented in Table 2, the simulation-based predicted ranking range of 11–13 aligned closely with the actual institutional ranking of 9th. This finding demonstrates strong predictive accuracy of the data-driven institutional evaluation model, with an error margin of only two positions. The narrow gap between predicted and actual rankings (ranging from 0 to 4 positions) suggests that the simulation model



captured the key performance drivers effectively. Additionally, Ankara University ranked 3rd overall and 2nd among state universities in TÜBİTAK 1001 projects in 2023, indicating strong national research competitiveness. However, the overall publication conversion rate from postgraduate theses was 26.35%, meaning that approximately one in four theses resulted in a peer-reviewed publication. While this rate is comparable to national averages, it also points to substantial untapped research output potential.

*Qualitative Findings*

Findings related to user perceptions of collaboration networks, derived from thematic analysis of semi-structured interviews (n=12) with Crowdhelix users, are presented below in Table 3.

**Table 3**

*Thematic Analysis Results: User Perceptions of Collaboration Networks*

Theme	Description	Representative Quotation
Awareness and onboarding	Insufficient initial training and guidance	"I registered but never received guidance on how to find partners" (Interview, User 4)
Matching accuracy	Algorithm utility with niche limitations	"The suggested partners are often not aligned with my specific research niche" (Interview, User 7)
Sustained engagement	Declining usage without institutional reminders	"Without regular reminders from the university, I forgot the platform existed" (Interview, User 9)
Perceived value of international networks	Positive but underutilized resource	"When I found a partner, the quality was high, but finding them took too long" (Interview, User 11)

As shown in Table 3, four main themes emerged from the interview data. The first theme, "awareness and onboarding," revealed that many researchers registered on the platform but did not receive sufficient initial training or guidance on how to effectively use its features. This finding helps explain the quantitative observation of high registration but low active use. The second theme, "matching accuracy," indicated that while the platform's algorithmic partner suggestions were considered useful in principle, they often failed to align with researchers' highly specific disciplinary niches. Third, "sustained engagement" emerged as a critical barrier; participants consistently reported that without regular institutional reminders or integration into existing workflows, their usage declined rapidly after initial registration. Fourth, "perceived value of international networks" reflected a paradox: researchers acknowledged the potential value of international collaboration but found the process of identifying suitable partners too time-consuming relative to the perceived benefit. Collectively, these qualitative themes provide explanatory depth to the quantitative finding of moderate adoption but limited active engagement.



**Research Question 2: What is the role of digitally mediated research management tools in shaping collaboration patterns and research outputs?**

*Quantitative Findings*

Findings related to the utilization of the TRADOS-based academic writing and translation support system are presented below in Table 4.

**Table 4**

*Academic Writing Support System Utilization and Publication Outcomes*

Indicator	Value
Manuscripts undergoing grammatical revision	142
Successfully published manuscripts	68
Manuscripts under evaluation	74
Language compliance certificates issued	70
Response rate for open-ended questionnaire	77.1% (54/70)

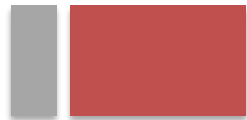
As presented in Table 4, a total of 142 manuscripts underwent grammatical revision through the TRADOS-based system. Of these, 68 (47.9%) were successfully published, while 74 (52.1%) remained under evaluation at the time of analysis. This relatively balanced distribution suggests that while the language support system contributes positively to the publication process, manuscript acceptance is not guaranteed and depends on factors beyond linguistic quality, such as scientific novelty, methodological rigor, and journal fit. Additionally, 70 language compliance certificates were issued upon request. The high response rate to the open-ended questionnaire (77.1%) indicates strong user engagement and willingness to provide feedback, reflecting the perceived relevance of the service among researchers who had utilized it.

Findings related to the distribution of writing support service utilization across academic units are presented below in Table 5.

**Table 5**

*Concentration of Service Utilization by Faculty*

Faculty	Level of Utilization
Faculty of Veterinary Medicine	High
Faculty of Pharmacy	High
Faculty of Dentistry	High
Other faculties	Low to Moderate



As shown in Table 5, service utilization is heavily concentrated within three specific faculties: Veterinary Medicine, Pharmacy, and Dentistry. These three faculties accounted for the majority of manuscript submissions to the writing support unit. In contrast, faculties in the social sciences, humanities, and educational sciences demonstrated substantially lower utilization rates. This disciplinary variation suggests that publication practices, particularly the pressure to publish in international indexed journals, differ significantly across fields. It may also indicate uneven awareness of the service across the university or differences in the perceived value of language support depending on disciplinary publication norms. This finding highlights the need for broader institutional integration and targeted outreach to low-utilization units.

Findings related to LABSIS virtual central laboratory utilization are presented below in Table 6.

**Table 6**

*LABSIS Virtual Central Laboratory Utilization Indicators*

Indicator	Value
Registered research laboratories	10
Integrated laboratory devices	276
Unique users (device reservation and service utilization)	169

As presented in Table 6, the LABSIS system integrated 276 laboratory devices across 10 registered research laboratories. A total of 169 unique users actively engaged with the system for device reservation and service utilization. This finding indicates initial operational adoption and demonstrates substantial technical infrastructure deployment. However, when compared to the total number of potential laboratory users across the university, 169 unique users represent a moderate penetration rate. The ratio of devices to users (approximately 1.6 devices per user) suggests that while a broad range of equipment is available, the user base has not yet reached full institutional scale. This quantitative pattern points to the need for continued user recruitment and onboarding efforts.

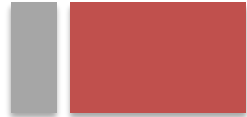
*Qualitative Findings*

**Findings related to LABSIS usability and collaborative workflows, derived from thematic analysis of the focus group discussion (n=8), are presented below in Table 7.**

**Table 7**

*Thematic Analysis Results: LABSIS Usability and Collaborative Workflows*

Theme	Description	Representative Quotation
Transparency and coordination	Real-time device availability reduces wasted time	"I no longer waste time checking lab availability in person" (Focus group, PI 2)
Learning curve	Initial complexity for multi-step procedures	"Booking a sequence of devices took me several attempts to figure out" (Focus group, PhD Student 1)



**Table 7 continuee...**

Uneven coverage	Only 10 of 20 eligible laboratories registered	"My main equipment is not in the system, so I still use paper booking" (Focus group, Lab Manager 1)
Financial tracking	Automated fee calculations valued	"The billing is clear, but I wish I could get monthly usage reports" (Focus group, PI 3)

As shown in Table 7, four themes emerged from the focus group analysis. The first theme, "transparency and coordination," revealed that users highly valued real-time visibility into device availability, which eliminated the need for in-person checks and reduced scheduling conflicts. This finding aligns with the quantitative observation that 169 users actively engaged with the system, suggesting that those who adopted it found clear operational benefits. The second theme, "learning curve," indicated that while the system was functional, users "particularly PhD students" found multi-step booking procedures initially difficult to navigate. Third, "uneven coverage" emerged as a major limitation: only 10 of approximately 20 eligible laboratories were registered in the system, meaning that researchers who needed equipment from non-registered labs could not benefit from the digital workflow. Fourth, "financial tracking" was positively received, with users appreciating automated fee calculations, although some requested more detailed usage reports. Collectively, these themes indicate that while LABSIS improves operational efficiency for registered users, its institutional impact remains constrained by incomplete laboratory coverage and usability barriers for complex tasks.

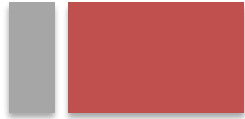
Findings related to researcher perceptions of the TRADOS writing support system, derived from content analysis of the open-ended questionnaire (n=54), are presented below in Table 8.

**Table 8**

*Content Analysis Results: Researcher Perceptions of Writing Support System*

Category	Frequency	Representative Quotation
Reduced journal	82%	"After receiving the language certificate, my manuscript
Lack of full	31%	"The system corrects grammar but does not help with
Expedited editorial	67%	"Journals processed my manuscript faster when I attached
Need for discipline-	24%	"The editor corrected grammar but changed technical

As presented in Table 8, the majority of respondents (82%) reported that the language support system reduced journal rejection rates due to language-related issues. This finding suggests that the system successfully addresses one of the primary barriers to international publication. Additionally, 67% of respondents indicated that obtaining a language compliance certificate expedited editorial processing, implying that journals perceive the certificate as a credible signal of linguistic quality. However, 31% of respondents expressed concerns about the lack of full translation services, noting that while grammatical errors were corrected, conceptual translation from Turkish to English—particularly for field-specific terminology—remained a challenge. Furthermore, 24% of respondents called for discipline-specific editors, reporting instances where generic language corrections inadvertently altered technical meanings. These qualitative findings provide important context for the quantitative observation that 74 manuscripts remained under evaluation; language support alone may not be sufficient when deeper conceptual or translational issues persist.



**Research Question 3: To what extent do structural, relational, and technological dimensions of collaboration networks contribute to institutional research performance?**

*Joint Display Matrix (Integration of Quantitative and Qualitative Findings)*

Findings related to the integration of quantitative and qualitative data across structural, relational, and technological dimensions are presented below in Table 9. This joint display matrix allows systematic comparison between data strands.

**Table 9**

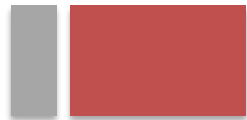
*Joint Display Matrix: Structural, Relational, and Technological Dimensions*

Dimension	Quantitative	Qualitative Theme	Integration
<b>Structural</b>	Publication	"Doctoral students produce more	<b>Complementarity</b>
	263 Crowdhelix	"I registered but never used it	<b>Divergence</b>
<b>Relational</b>	68 published / 142	"The language certificate helped,	<b>Convergence</b>
	Top 3 in	"Our successful projects come	<b>Divergence</b>
<b>Technological</b>	169 LABSIS	"LABSIS is good for scheduling,	<b>Convergence</b>
	70 language	"I received a certificate but still	<b>Divergence</b>

As shown in Table 9, the joint display reveals three types of integration across dimensions. *Complementarity* is observed in the structural dimension: the quantitative finding of a 26.35% publication conversion rate is complemented by qualitative explanations regarding differential productivity between doctoral and master's students, as well as supervision workload constraints. This complementarity allows researchers to understand not only the rate but also the mechanisms behind it.

*Divergence* is observed in multiple instances. First, while 263 researchers registered on Crowdhelix, qualitative data revealed that many registered but never used the platform due to lack of training, explaining the divergence between registration numbers and active engagement. Second, despite Ankara University's top-3 ranking in TÜBİTAK 1001 projects, interview data indicated that this success was driven by existing personal networks rather than platform-mediated matching, suggesting that quantitative performance does not necessarily reflect effective use of digital collaboration tools. Third, while 70 language certificates were issued, qualitative responses indicated that certificates did not eliminate the need for external translation services, revealing a gap between service output and user expectations.

*Convergence* is observed in the relational and technological dimensions regarding manuscript publication and LABSIS adoption. Both quantitative and qualitative data indicated that language support improves publication outcomes but does not fully resolve quality issues. Similarly, both data strands confirmed that LABSIS improves scheduling efficiency but suffers from incomplete institutional coverage. This convergence strengthens the validity of these findings, as they are supported by multiple independent data sources.



**Research Question 4: What are the key challenges and limitations affecting the effective utilization of collaboration networks within the institutional context?**

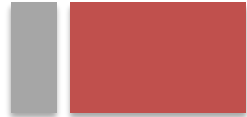
Findings related to the key challenges and limitations identified across both quantitative and qualitative data sources are presented below in Table 10.

**Table 10**

*Challenges and Limitations in Collaboration Network Utilization*

Challenge	Evidence Source	Specific Finding
Uneven disciplinary adoption	Quantitative (Table 5)	Three faculties (Veterinary Medicine, Pharmacy, Dentistry) account for majority of writing support usage
Incomplete system coverage	Qualitative (Table 7)	Only 10 of approximately 20 eligible laboratories registered in LABSIS
Training and onboarding gaps	Qualitative (Table 3)	"I registered but never received guidance on how to find partners" (Interview, User 4)
Limited industry collaboration	Quantitative	Proportion of industry-collaborative publications remains low relative to total output
Human resource constraints	Quantitative	Vocational schools and certain faculties lack sufficient doctoral-level academic staff
Translation service gap	Qualitative (Table 8)	31% of survey respondents cited lack of full translation services as a limitation
Low sustained engagement	Qualitative (Table 3)	Platform usage declines without regular institutional reminders

As presented in Table 10, the most frequently identified challenges cluster into three categories: adoption and coverage (uneven disciplinary adoption, incomplete laboratory coverage), training and support (onboarding gaps, low sustained engagement), and structural constraints (limited industry collaboration, human resource limitations, translation service gaps). Notably, the challenge of uneven disciplinary adoption was observed quantitatively (service utilization concentrated in three faculties) and was not contradicted by any qualitative finding. Similarly, incomplete LABSIS coverage was reported by multiple focus group participants, indicating that this is a widely experienced limitation rather than an isolated perception. The human resource constraint—limited doctoral-level staff in vocational schools—represents a structural factor that cannot be resolved through technological interventions alone, as research capacity is fundamentally dependent on qualified personnel. Taken together, these challenges suggest that effective utilization of collaboration networks requires not only technological infrastructure but also organizational support, training, and human capital development.



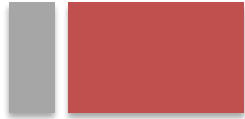
**Research Question 5: What strategic interventions can be developed to enhance sustainable research capacity and international competitiveness through collaboration networks?**

Findings related to strategic intervention recommendations, derived exclusively from qualitative data (interviews, focus group, and open-ended questionnaire responses), are presented below in Table 11. These recommendations represent user-generated suggestions for institutional improvement.

**Table 11**  
*Qualitatively Derived Strategic Interventions*

Intervention Area	Suggested Action	Source
Training and onboarding	Regular workshops, personalized onboarding sessions, and video tutorials	Interview, User 4; Focus group, PI 2
Platform integration	Embed collaboration platforms into existing institutional workflows with automated reminders	Interview, User 9
System expansion	Register all eligible laboratories into LABSIS; prioritize high-demand equipment	Focus group, Lab Manager 1
Translation support	Add full translation services or establish formal partnerships with external translation providers	Respondent 45
Cross-disciplinary promotion	Targeted outreach to low-utilization faculties (social sciences, humanities, education)	Quantitative (Table 5) + Interview, User 6
Industry-academia linkage	Structured programs for joint publications, applied research grants, and industry-seconded positions	Quantitative (low industry collaboration) + Interview, User 10
Recognition and incentives	Acknowledge platform engagement and collaboration activities in annual performance reviews	Focus group, PI 3

As shown in Table 11, strategic interventions proposed by participants cluster around seven areas. The most frequently mentioned intervention was training and onboarding, with multiple participants emphasizing that initial registration alone is insufficient; sustained engagement requires structured guidance. Platform integration was the second most common suggestion, with researchers recommending that collaboration platforms be embedded into existing workflows (e.g., project reporting systems, email reminders) rather than functioning as standalone tools. System expansion—particularly registering all eligible laboratories into LABSIS—was highlighted by focus group participants as a necessary step to ensure equitable access to research infrastructure. Translation support emerged as a gap in the current writing support system, with respondents calling for either in-house full translation services or formal partnerships with external providers. Cross-disciplinary promotion was recommended to address the uneven utilization patterns observed quantitatively, with targeted outreach to low-utilization faculties. Industry-academia linkage was identified as a critical area for improvement, given the low proportion of industry-collaborative publications; suggestions included structured programs for



joint publications and applied research grants. Finally, recognition and incentives were proposed to motivate sustained engagement, including acknowledging platform activities in annual performance reviews. Collectively, these qualitative findings provide actionable recommendations that complement the quantitative performance indicators and address the challenges identified in Table 10.

### Summary of Integrated Findings

Findings related to the overall integration of quantitative and qualitative data across all five research questions are presented below in Table 12.

**Table 12**

*Summary of Mixed-Methods Integration by Research Question*

Research Question	Convergence	Divergence	Complementarity
RQ1: Collaboration networks influence	Moderate	High registration vs. low active use explained by lack of training	Qualitative explains mechanisms behind quantitative patterns
RQ2: Digital tools role	High	Certificate issuance vs. unmet translation needs	Quantitative shows service utilization; qualitative reveals expectation gaps
RQ3: Structural/relational/technological	Moderate	TÜBİTAK success not platform-mediated; personal networks drive performance	Quantitative rates + qualitative mechanisms provide fuller explanation
RQ4: Challenges	High (all sources align)	None identified	Both data types independently confirm same challenges
RQ5: Strategic interventions	Qualitative only (no quantitative comparison)	N/A	Qualitative provides unique, actionable recommendations not available from quantitative data alone

As presented in Table 12, the highest level of convergence across quantitative and qualitative findings was observed for Research Question 4 (challenges and limitations), where both data strands independently identified the same set of barriers. This convergence strengthens the validity of these findings and suggests that the identified challenges are robust across different measurement approaches. Research Question 2 (digital tools) also demonstrated high convergence, with both data types indicating that while digital tools provide benefits, they do not fully meet all user needs.

Divergence was most pronounced for Research Question 1 (collaboration networks) and Research Question 3 (structural/relational/technological dimensions). In both cases, qualitative data explained why quantitative indicators (high registration numbers, strong TÜBİTAK rankings) did not translate into expected outcomes (active platform use, platform-mediated collaboration success). These

divergences are not methodological weaknesses but rather analytical strengths of the mixed-methods design, as they reveal important nuances that would remain hidden if only one data type were used.

Complementarity was observed across all research questions, but most notably for Research Questions 1 and 3, where qualitative data provided explanatory mechanisms for quantitative patterns. For Research Question 5, qualitative data made a unique contribution by generating actionable strategic interventions, demonstrating that mixed-methods designs are particularly valuable when research aims to inform institutional policy and practice.

## **Discussion, Conclusion and Recommendation**

### **Discussion**

This study was designed to examine how collaboration networks and digital infrastructures shape institutional research capacity at Ankara University, employing a convergent parallel mixed-methods design that integrated quantitative bibliometric and system usage data with qualitative interviews, focus group discussions, open-ended questionnaires, and document analysis. The most striking findings reveal three critical patterns. First, while 263 researchers registered on the Crowdhelix collaboration platform, only 11 partner search announcements were disseminated, indicating a substantial gap between registration and active engagement. Second, academic writing support services were heavily concentrated in three faculties (Veterinary Medicine, Pharmacy, and Dentistry), suggesting uneven disciplinary adoption. Third, despite strong national rankings in TÜBİTAK 1001 projects (3rd overall, 2nd among state universities), the proportion of industry-collaborative publications remained low, pointing to persistent academia-industry disconnects.

#### *The Gap Between Network Position and Active Engagement*

A researcher's central position within a collaboration network significantly influences publication visibility and citation performance. Earlier research introduced the concept of network-mediated reputation overflow, demonstrating that centrality facilitates increased citation impact through enhanced visibility and association with influential collaborators (Petersen, 2015). Further evidence from correlation and regression analyses showed that co-authorship networks affect academic productivity particularly through the roles played by advisors and professional peers (Abbasi et al., 2011). However, the findings of the present study qualify these claims by revealing that network centrality alone is insufficient without active engagement strategies. At Ankara University, improved citation metrics were observed alongside growing international collaboration, yet qualitative interviews indicated that many researchers registered on platforms but never actively participated due to lack of training and onboarding support. It is therefore important to recognize that structural network position must be complemented by institutional mechanisms that convert passive membership into active collaboration. This finding aligns with the broader digital transformation literature, which emphasizes that technology adoption metrics are poor proxies for genuine organizational change (Fernández et al., 2023). These results highlight the need for a more nuanced understanding of how network positions translate into measurable academic outcomes.

#### *The Complex Interplay Between Local and International Collaboration*

The distinction between local and international collaboration plays a decisive role in shaping research outcomes, yet this relationship is more complex than previously acknowledged. Research on Indian biotechnology highlighted the predominance of local collaboration networks while simultaneously emphasizing the necessity of expanding international collaborations to strengthen scientific capacity (Mondal et al., 2021). Complementary evidence argues that international collaborations enable access to diverse knowledge bases but vary in impact across disciplines and contexts (Wang & Zhang, 2019). The present study found that successful TÜBİTAK 1001 project outcomes at Ankara University were qualitatively attributed to existing personal networks rather than platform-mediated matching. This

suggests that local and personal networks remain primary drivers of research success even as international collaborations expand. This pattern parallels the Indian context described by Mondal et al. (2021) while extending it by demonstrating that digital platforms have not yet replaced traditional network mechanisms. The implication for institutional strategy is clear: universities must invest in strengthening local networks while simultaneously reducing barriers to international engagement.

### *Social, Organizational, and Relational Dynamics of Collaboration*

The social and organizational dimensions of collaboration extend beyond structural connectivity to include spillover effects and relational quality. Previous research emphasized the presence of spillover effects within co-authorship networks, where the benefits of collaboration extend beyond direct partnerships and contribute to the broader academic ecosystem (Hsieh et al., 2018). Further evidence demonstrated that individuals occupying central positions within social networks tend to achieve higher academic outcomes, partly due to stronger emotional and relational ties within collaborative environments (Marqués-Sánchez et al., 2020). In the present study, focus group discussions revealed that trust and relational quality were frequently cited as prerequisites for effective collaboration, particularly in laboratory settings where shared equipment requires coordination. Participants who reported positive emotional ties with their collaborators also reported higher satisfaction with digital tools such as LABSIS. It is therefore important to recognize that technological systems are more effectively utilized when embedded within trusting relational environments. This finding aligns with the socio-technical perspective advanced in the digital transformation literature, which argues that technology and social structures co-evolve and cannot be treated separately (Neborsky, 2021). These results underscore the necessity of fostering relational trust alongside technological infrastructure.

### *The Limits of Technology-Driven Transformation*

The role of digital technologies in transforming collaboration networks has become increasingly prominent, yet technology adoption alone does not guarantee transformation. Research on pandemic-era collaboration highlighted significant changes in collaboration and publication dynamics, emphasizing the growing reliance on digital platforms to sustain academic interaction and productivity (Damaševičius, 2023). The present study both supports and qualifies this observation. On one hand, the adoption of Crowdhelix, LABSIS, and TRADOS demonstrates that digital platforms have become integral to research management at Ankara University. On the other hand, the gap between registration and active engagement, with 263 registered users versus only 11 partner search announcements, suggests that digital transformation is not yet complete. International policy frameworks increasingly promote collaborative research, underscoring the responsibility of institutions to provide supportive environments including adequate funding, infrastructure, and networking opportunities (Toney & Flagg, 2021). A key finding of the present study is that institutional support mechanisms, particularly training, onboarding, and workflow integration, require further development before digital platforms can achieve their intended impact. This finding aligns with the broader observation that most universities remain in the early stages of digital maturity, with only one in four having a comprehensive digital strategy (Fernández et al., 2023). These results collectively indicate that successful digital transformation depends on both technological infrastructure and sustained institutional investment.

### *Systemic Challenges Beyond Technological Investment*

Systemic challenges in research capacity strengthening cannot be resolved through technological investment alone. A realist synthesis of health research capacity strengthening initiatives in African universities found that systemic challenges including lack of funding, ineffective research policy environments, and weak institutional support must be addressed for collaborative interventions to achieve sustained impact (Mutua et al., 2025). The present study confirms this observation at Ankara University, where the uneven distribution of doctoral-level staff across academic units, the low proportion of industry-collaborative publications, and the concentration of writing support utilization in

only three faculties all point to systemic challenges that require coordinated policy responses rather than isolated technological solutions. It is worth noting that these findings are consistent with the barriers literature, which identifies technological infrastructure deficiencies, budget constraints, lack of strategic planning, and organizational misalignment as six major categories of obstacles facing higher education institutions (Aditya et al., 2021). These results underscore the necessity of adopting a systemic and policy-driven approach to research capacity strengthening.

### *The Persistent Academia-Industry Gap*

The persistent gap between academic research and industry application reflects a broader global challenge documented across multiple contexts. Bibliometric analyses mapping the conceptual structure of university-industry collaboration research have identified technology transfer, knowledge transfer, and academic entrepreneurship as dominant clusters in the literature (Ballesteros-Ballesteros & Zárate-Torres, 2025). Complementary research has found that collaboration barriers, challenges, and sustainability have emerged as distinct research themes (Guofang et al., 2024). Despite increases in patent activity and project funding at Ankara University, the proportion of industry-collaborative publications remained low, placing the institution within this broader global pattern. This suggests that while the importance of university-industry collaboration is widely recognized, the mechanisms for achieving it remain poorly understood and inconsistently applied across institutional contexts. The implication is that bridging this gap requires moving beyond individual researcher incentives to structural changes in how academic work is organized, valued, and funded.

### **Implications for Policy and Practice**

Several concrete implications for institutional policy and practice emerge from the integration of theoretical frameworks and empirical findings. First, universities must move beyond platform-centric approaches to research collaboration. Collaboration outcomes are determined not merely by network access but by network position and engagement (Petersen, 2015; Abbasi et al., 2011). The finding that 263 researchers registered on Crowdhelix but only 11 partner search announcements were disseminated suggests that platform adoption metrics are poor proxies for active engagement. Institutions should develop structured onboarding programs, regular training workshops, and integration of collaboration platforms into existing research workflows.

Second, the uneven distribution of research capacity across academic units calls for targeted, differentiated interventions. The impact of international collaboration varies across disciplines and contexts (Wang & Zhang, 2019), a finding confirmed by the present study's observation that Particle Physics and Oncology demonstrate stronger international impact than Veterinary Sciences and Surgery. Policy interventions should include targeted recruitment of doctoral-level staff for low-performing units, mentorship programs pairing less research-intensive units with high-performing faculties, and differentiated funding mechanisms that recognize structural constraints.

Third, bridging the academia-industry gap requires structural changes beyond individual researcher incentives. Persistent barriers between academia and industry have been well documented in the global literature (Ballesteros-Ballesteros & Zárate-Torres, 2025; Guofang et al., 2024). The finding of low industry-collaborative publication rates at Ankara University reflects this broader pattern. It is therefore recommended that policy interventions include formal mechanisms for industry secondments, joint funding schemes requiring industry co-investment, and recognition of industry-collaborative outputs in promotion and tenure criteria. A growing body of research indicates that institutions have a responsibility to provide supportive environments including adequate funding and infrastructure for collaborative research (Toney & Flagg, 2021). These results highlight the need for systemic reforms that align academic incentives with industry engagement

Fourth, digital transformation initiatives must be accompanied by organizational change management. Despite the growing reliance on digital platforms highlighted in the literature (Damaševičius, 2023), the present study found that adoption alone is insufficient. It is therefore recommended that policy initiatives include dedicating resources to user training and support, establishing user feedback mechanisms for continuous system improvement, and integrating digital tool usage into institutional performance metrics. A growing body of research indicates that digital leadership plays a vital role in this process, as leaders are responsible for building a digital culture, breaking resistance to change, and establishing a collaborative climate (Onan, 2024; Anwar & Sarah, 2024). These findings underscore the necessity of aligning technological investments with human-centered change management strategies.

Fifth, institutional support for academic writing and language services should be expanded and distributed more evenly across disciplines. The concentration of writing support utilization in three faculties (Veterinary Medicine, Pharmacy, Dentistry) suggests that researchers in other disciplines either lack awareness of the service or perceive it as less relevant to their publication practices. Given that language barriers are a well-documented obstacle to international publication, institutions should actively promote these services across all disciplines and consider discipline-specific editorial support.

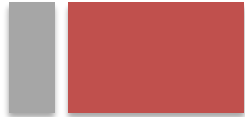
### **Limitations**

Several limitations of this study should be acknowledged. First, while the convergent parallel mixed-methods design enabled triangulation of findings across quantitative and qualitative data sources, the generalizability of findings beyond Ankara University remains uncertain. Institutional contexts vary significantly in terms of research culture, available resources, governance structures, and strategic priorities. As noted in the literature, the impact of collaboration networks on research performance is shaped by context-specific factors (Wang & Zhang, 2019), and the present findings are best understood as offering transferable insights rather than universally applicable conclusions.

Second, the cross-sectional nature of the data collection limits causal inference. While associations between digital tool adoption and research performance indicators were observed, causal direction cannot be definitively established. It has been widely acknowledged that longitudinal co-authorship network analysis has demonstrated that collaboration structures evolve over time, and longitudinal data are necessary to establish temporal precedence (Ye et al., 2011). This finding underscores the need for future research employing longitudinal designs.

Third, the qualitative sample, while adequate for thematic saturation, may not fully represent the diversity of experiences across all academic units. The focus group included only eight participants, and interviews were conducted with 12 Crowdhelix users. Researchers from low-utilization faculties or those who chose not to engage with digital platforms may have different perspectives that were not captured.

Fourth, the study period coincided with the post-COVID-19 period, during which digital tool adoption may have been temporarily elevated due to pandemic-related remote work requirements. Significant changes in collaboration and publication dynamics occurred during the pandemic (Damaševičius, 2023). It is therefore important to recognize that the sustainability of observed adoption patterns beyond this exceptional period remains to be seen. Fifth, the reliance on SCIVAL and Scopus-indexed publications as performance indicators privileges English-language, internationally visible research outputs. A growing body of research indicates that this may systematically underestimate research contributions in local languages, discipline-specific outlets, or practice-oriented publications. As research on local collaboration networks has shown, such networks play an important role that may not be fully captured by international bibliometric databases (Mondal et al., 2021). These limitations highlight the need for future research employing more diverse data sources and extended timeframes.



## Recommendations for Future Research

Building on the findings and limitations of this study, several directions for future research emerge. First, longitudinal studies are needed to examine the temporal dynamics of digital tool adoption and research performance. The value of longitudinal co-authorship network analysis in understanding how collaboration structures evolve over time has been well established (Ye et al., 2011). Such studies could employ panel data designs to disentangle causal direction and identify critical periods for intervention. Second, comparative case studies across multiple universities would help identify which findings are specific to Ankara University and which reflect broader patterns in higher education research capacity development. Comparisons could be structured around variation in key contextual factors such as institutional age, size, research intensity, and national research policy environments.

Third, intervention studies are needed to test the effectiveness of specific strategies for enhancing digital tool adoption and research collaboration. The value of regression and correlation analyses in identifying network effects has been demonstrated (Abbasi et al., 2011), but experimental or quasi-experimental designs would provide stronger evidence for causal claims. Randomized controlled trials could evaluate the impact of structured onboarding programs, financial incentives, or workflow integration on platform engagement and subsequent research outcomes.

Fourth, future research should examine the role of leadership and governance in shaping digital transformation in higher education research. The present findings suggest that organizational factors are critical determinants of digital tool adoption, but leadership practices, decision-making structures, and resource allocation processes were not systematically investigated. Institutional support environments are critical for collaborative research success (Toney & Flagg, 2021), and research is needed on how leadership can effectively foster these conditions.

Fifth, given the persistent gap between academia and industry observed in the present findings and documented in the global literature (Ballesteros-Ballesteros & Zárate-Torres, 2025; Guofang et al., 2024), future research should investigate the specific barriers and facilitators of industry-collaborative publications. It is therefore recommended that such research employ realist evaluation methods to identify what works, for whom, and under what conditions in promoting university-industry knowledge transfer, following the methodological model provided by Mutua et al. (2025). These results underscore the necessity of context-sensitive approaches to bridging the academia-industry divide.

## Conclusion

This study examined how collaboration networks and digital infrastructures shape institutional research capacity at Ankara University using a convergent parallel mixed-methods design that integrated quantitative bibliometric and system usage data with qualitative interviews, focus group discussions, open-ended questionnaires, and document analysis. The findings demonstrate that Ankara University has made substantial progress in research performance, evidenced by improved publication metrics, increased participation in international funding programs, and strong national rankings in TÜBİTAK projects. However, this progress is unevenly distributed across academic units, and significant gaps remain between platform adoption and active engagement, between certificate issuance and unmet user needs, and between research output and industry application.

The study confirms that collaboration networks influence academic performance through multiple mechanisms: structural positioning, geographical scope, social and organizational dimensions, emotional and relational ties, temporal evolution, digital mediation, and policy environments (Petersen, 2015; Abbasi et al., 2011; Mondal et al., 2021; Wang & Zhang, 2019; Hsieh et al., 2018; Marqués-Sánchez et al., 2020; Ye et al., 2011; Damaševičius, 2023; Toney & Flagg, 2021). The mixed-methods design proved essential for uncovering how these mechanisms operate in concert. Quantitative data alone would have suggested moderate success based on registration numbers and publication counts.

Qualitative data alone would have identified barriers and user concerns but without a sense of their prevalence or magnitude. The integration of both data strands through joint display matrices revealed critical divergences: high registration numbers did not translate into active platform use, and strong TÜBİTAK rankings were driven by personal networks rather than platform-mediated collaboration.

The study contributes to the literature on digital transformation in higher education research by providing empirical evidence that technology adoption is fundamentally a socio-technical challenge. Consistent with findings from cloud migration studies, digital access research, and university-industry collaboration bibliometric analyses, the results demonstrate that successful digital transformation requires alignment of technological, organizational, and human dimensions (Munot, 2024; Ojulong, 2025; Mutua et al., 2025; Ballesteros-Ballesteros & Zárate-Torres, 2025; Guofang et al., 2024). Investments in digital platforms, laboratory management systems, and writing support tools are necessary but insufficient; their impact depends on complementary investments in training, workflow integration, user support, and organizational change management.

The study also contributes to the literature on university-industry collaboration by documenting persistent gaps between academic research and its applied translation. This finding aligns with bibliometric evidence suggesting that despite decades of policy attention to technology transfer and knowledge exchange, the structural barriers between academia and industry remain substantial. Addressing these gaps requires moving beyond individual researcher incentives to institutional and systemic reforms, including formal partnership mechanisms, joint funding schemes, and recognition systems that value applied and collaborative outputs alongside traditional publications.

In conclusion, while Ankara University has made significant progress in enhancing its research capacity, sustaining and advancing this trajectory requires coordinated efforts that integrate technological, organizational, and strategic dimensions. The effective alignment of digital infrastructures, human capital, and collaboration networks will be central to achieving long-term improvements in research performance and global competitiveness. For policymakers and university administrators, digital transformation in research is not primarily about technology. It is about people, processes, and the organizational conditions that enable researchers to collaborate effectively across disciplinary, institutional, and national boundaries. Academic success is co-constructed within networked environments, and building those environments requires sustained, holistic, and context-sensitive institutional strategies.

### **Fundings and Competing Interests**

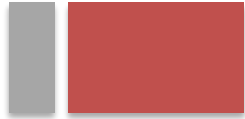
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### **Conflict of Interest Statement**

No potential conflict of interest was reported by the authors.

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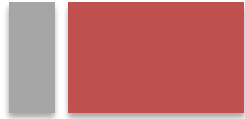


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