

# Network Analysis of East Asian Research in South Korea for the 2004-2013 Period

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## Abstract

*In the past decade, East Asian Research has received attention from researchers as well as in South Korea society-at-large. The broad category of East Asian Research includes various disciplinary fields, such as "history, economics, and politics; however, few studies have used quantitative analysis to explore its development. In this paper, we used network analysis to identify the disciplines and active research areas, focusing on productivity, collaboration patterns, and citation networks of East Asian Research in South Korea. For this study, 6,646 journal publications related with East Asian Research and indexed by KCI (Korean Citation Index) during the 10-year period of 2004-2013 were considered. Results show that East Asian Research was led during this period by sole-researchers, rather than interdisciplinary studies. Moreover, a co-institution network represents active institutions with a high degree and collaborative centrality. In terms of journal-journal citation networks, journals belonging to both "history" and "Korean literature" disciplines were dominant.*

**Key words:** East Asian Research, Network Analysis, Co-authorship, Citation, Korean Citation Index.

## 1. INTRODUCTION

This study is motivated by the question of what East Asian Research (hereafter, EAR) is for. The name "East Asia" is closely related to changes in the colonial history of East Asian countries such as South Korea (hereafter, Korea), China, and Japan as well as the modern history of Western countries. Historical events in these countries have developed and interacted with one another, giving rise to EAR. However, a closer examination reveals the existence of EAR with an interdisciplinary background including not only its history but also its society, economy, and politics, among others. [18] has defined interdisciplinary research as a field too wide or large to be properly handled by experts in a given area and thus suggested that topics in this field are difficult to address. Thus, current study starts by questioning "What academic fields compose the EAR?" [27] has classified the scholarly discourse on EAR in Korea into four types: discourse on the economy community, discourse on political security, discourse on the East Asian identity, and discourse on alternative systems. This classification frequently crosses boundaries of several

disciplines. While his approach has produced a new perspective for EAR, it is based on personal judgments.

There are several ways to grasp the interdisciplinary nature of a particular field: collaboration between researchers, an analysis of keywords in journal articles, citations and co-citations across studies, and an analysis of relationships or website links [14], [24]. For example, previous research has employed the citation network similarity between journals to clarify the interdisciplinary nature of certain journals by calculating various centrality measures used mainly in the social network analysis method [21], [22].

In a given EAR field, efforts to identify current research areas, patterns, and research outcomes can provide a better understanding of the whole field, facilitating its development. In addition, these efforts can provide important suggestions for future research. In the past, researchers in Korea have analyzed academic environments of particular fields of EAR in various ways. However, such efforts have been limited to the field of science and technology [26], [15], [16] or conducted in the field of informetrics, including business intelligence [28] and library and information science [29]. By contrast, few studies have quantitatively analyzed the academic environment of EAR.

Some studies outside of Korea, also have taken a quantitative approach to EAR. [19] has analyzed research activities in the field of communication in China by analyzing

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cited relationships between journals related to communication science in China and journals related to China and Asia and demonstrated weak cited relationships with China- and Asia-related journals in the field of communication research, an area reflecting a multidisciplinary nature. By contrast, they found strong citation relationships for the researcher's affiliation. In addition, [5] has examined characteristics of international relations and cooperation between Asian researchers through an analysis of coauthor relationships in the field of library and information science.

Unlike recent attention to East Asia, few studies have taken a Scientometrics approach to the analysis of the academic environment of EAR. In this regard, the present study quantitatively identifies the intellectual structure of this research area by analyzing East Asia-related articles published in Korea and investigates the developmental characteristics of EAR based on temporal changes. In addition, unlike previous studies based on international abstracts and indexing databases (A&HCI/SSCI/SCI/Scopus), this study employs the Korean academic database KCI (Korea Citation Index) to examine research trends in Korea. The use of this national academic database is expected to better reflect the locality of EAR in Korea.

Then, how can the reality of EAR be captured? The present study clarifies the profile of EAR published in Korea, in order to identify its interdisciplinary nature and current position. The study expects various EAR fields to be closely related to one another in their ideological and cultural contexts as well as political and economic contexts.

In this regard, present study examines the intellectual structure of EAR and sets research questions based on the aforementioned studies as follows:

1. How is the production mode of EAR publications in Korea formed?
2. How is the network structure of EAR publications in Korea formed?
3. How is the citation structure of EAR publications in Korea formed?

## 2. LITERATURE REVIEW

### 2.1 Characteristics of EAR

EAR in Korea emerged in the 1990s and is now a mainstream field. However, although it has been a long time since EAR emerged in Korean academia, the field is yet to be unified into a field with a single branch. Instead, it follows a path of diversification rooted in a variety of disciplines because it has developed sporadically in many areas, including humanities, social sciences, and politics as a result of factors such as historicity, politics, and sociality, key elements of EAR.

Based on this background, it is difficult to rule out the historical background of EAR. [32] has investigated research trends in modern history by analyzing journal publications, books, and doctoral theses and found that the term "East Asia" is an essential stem of Korea's modern history. [6] has suggested the flow of change in consciousness within East Asia by comparing ancient and modern East Asia and Cold War and

present periods. On the other hand, [20] recognized that East Asian discourse reflects a full range of areas but noted that EAR is more likely to be directly connected to practical issues than other areas of academic discourse because it focuses on political and social situations in Korea. He discussed EAR by classifying it into three areas: First, he critically reviewed EAR for the *Changbi* (creation and criticism) group, which represents critical writers and intellectuals in Korea who started in 1966 with the founding of Quarterly *Changbi* (<http://en.changbi.com/history/>), and dealt with the continuing problem of nationalism. Second, he reviewed the work of the East Asian Institution at Sungkonghoe University, which has focused on cultural regionalism and the Cold War culture. Third, he focused on the discussion of the Korean wave in East Asian cultural studies in Korea. And he found that those studies analyzing EAR have focused mainly on the societal development and change by time and country. [13] has also analyzed characteristics of EAR, classifying it into four branches: the theory of Confucian capitalism, the unification of political and economic areas, postmodern civilization, and critical regionalism. He used this classification to examine how EAR in Korea has been integrated with socio-political-economic problems in Korea.

In this way, previous studies of EAR have attempted to grasp its ideological lineage based on the historical background of East Asia. However, based on studies borrowing from EAR, the aforementioned studies by Wang and Choi are founded on longitudinal studies based on the historical background. In addition, the studies by Lee and Im can be seen as cross-cutting studies analyzing the flow of contemporary research. These studies provide that EAR occupies an active position with available topics and that there is a diverse range of possible topics. However, there is a diagnosis that "it has demonstrated powerful impacts coupled with the most realistic issues of political economy and cultural area for the past 20 years" and that "it looks plenty but it is just bubbling in fact [2], [31]."

Before the analysis, defining the scope of EAR is important. Existing categories of EAR have been organized from the perspective of various studies in fields such as geography, culture, politics, and the economy. This study examines the structure of EAR across multiple disciplines that explore within the scope of Korea.

### 2.2 Scientometrics studies related to EAR

Scientometrics studies generally investigate the literature exchange between scholars, the academic nature of a given field, and research activities of researchers based on objective statistical data derived from a quantitative analysis of studies in various areas of a particular field [12]. This research method has been developed [23] and [30], who started to analyze bibliometric data sets for the first time to quantitatively measure the productivity of individual scientists and laboratories. The bibliometric data analysis method has evolved substantially because of the development of information technology and the massive digitization of the literature in the last decade. In addition, there is an aspect of the social network method rising on the other side. Earlier, this method was an old technique for mathematically representing a social network with a network or graph in social sciences [33].

However, the increase in computing power, coupled with the digitization of bibliographic information, has enabled an analysis of citation networks of hundreds of thousands or even millions of nodes and links. In a data set that generally contains bibliographic information, a node indicates an author or paper, and a link, a citation related to a node, an author relationship, or other bibliographic information. Various types of bibliographic information can be obtained from raw data and used in various ways to find authors, institutions, journals, and publication dates as well as citation information. However, such bibliographic information can cause some problems when configuring a collaborative network of scholars. The order of names can be problematic when scholars use different names or include middle names in papers. Because of this, raw data are required for refinement purposes prior to a mechanical analysis.

Studies have actively measured the productivity of individual scholars or laboratories. In addition, studies have attempted to reveal the intellectual structure of a particular area by applying quantitative information techniques to the academic sector [7] composed a network of accounting-related journals by using KCI data and analyzed it through a social network analysis and found a need to encourage more diverse interdisciplinary research. Reflecting the recent interdisciplinary atmosphere, [11] identified the structure of interdisciplinary journals in medical informatics and identified their intellectual structure by analyzing emerging author co-citations and words simultaneously.

Many characteristics of EAR have been analyzed through qualitative methods, but few studies have employed quantitative methods. Therefore, we focus on the network methods that reveal the intellectual structure of various academic fields.

### 3. METHOD

#### 3.1 Data collection

In order to examine recent research issues, researchers usually analyze various information resources such as academic papers, patents, and Web documents [34]. In this study, to investigate the intellectual structure of EAR, textual information on 6,646 papers produced from 2004 to 2013 extracted from the KCI database, managed by the National Research Foundation (NRF) of Korea, was employed. The KCI database retains a reliable bibliographic data on publications produced in Korea within seven days from academic associations [1]. A pre-test was conducted using various keywords ("EAST ASIA" in Korean and English, and "EASTERN ASIA") from the KCI website first to collect East Asia-related papers in the KCI database. As a result, "East Asia" in Korean was identified as a suitable query embracing other keywords. Therefore, the keyword "East Asia" was selected. Papers on East Asia published since 2002 appeared in the KCI database. However, the KCI database has been managed since 2004 by the NRF. Because information is uploaded by journals on a voluntary basis, the data were limited to papers produced since 2004. To examine related papers sorted by year, papers with the keyword "East Asia" downloaded from the KCI database for the 2004-2014 period were used. Up to 200 papers

can be downloaded from the KCI database. By downloading papers for each year, it was possible to collect all papers within the maximum limit. As a result, a total of 6,646 papers published in the journals included in the KCI for 10 years were collected.

Also, the web version of KCI materials was used for the data, including citations of domestic journals. However, only cited data on papers published from 2008 to 2011 were accessed. In other words, the material used in this study was the data set of papers over a three-year period as of 2011. Then the list and frequency of the journals in terms of being cited and citations of individual journals were used as cross-citation information to examine a citation network of relevant journals about East Asia. The total number of papers on East Asia during the 2008-2011 period provided by the citation database was 1,023 (June 17, 2014). Among these 1,023 papers, 298 were cited more than five times. And the number of journals cited fewer than five times during 4 years was 135. These journals belonged to 33 subcategories.

Various network analyses as well as basic descriptive statistics were employed. The descriptive statistics were classified into some categories, including changes in the number of papers by year, changes in the number of authors by year, and changes in the number of institutions producing papers by year, among others. The network analysis consisted of networks of coauthor institutions and major journals. The network analysis defined two networks: one of authors and another of papers. Prior study [35] demonstrated classification problem of synonymous and homonymous author names in citation data. Thus, author names were manually examined in this study.

#### 3.2 Network analysis

The network analysis method is often used to analyze the social and communication structure [36]-[38]. Here the social structure is the subject of analysis and is clearly defined as the morphology of social relationships or patterns of social linkages [17], [39]-[41]. An anthropological approach to the initial analysis of the social network structure restricts the subject of nodes, relationships between humans, and their interactions. However, recent studies of social networks extend the range of nodes. Here a node designates a unit connected to a relationship and enlarges from an individual to a group, organization, society, or country. In this way, relationships between humans, groups, countries, or relationships can be revealed in interactions between logical analysis units [1], [4].

This study mainly considers centrality analysis among other network techniques. Network centrality analysis reveals those nodes responsible for exchanging information and opinions across members of a group. That is, the analysis searches for a member playing a prominent role in the network by making it possible to deliver information and opinions efficiently. In this regard, the problem facing the group may be solved effectively [6], [25], [27].

Network centrality indicators reflect the degree to which one actor is located at the center of the whole network. These indicators include degree centrality, closeness centrality, and betweenness centrality. Degree centrality quantifies the degree to which a node is located at the center by establishing how

deeply the node is connected to others [32]. That is, the degree centrality of a node expresses the number of nodes to which the node is directly connected. In a coauthor network in terms of author's affiliated institution, this indicator was used to reflect the number of coauthor institutions to which relevant institutions were connected. In a directed network, the degree centrality of nodes can be classified into indegree centrality and outdegree centrality depending on the direction of links. In the journal citation network, cited and citation relationships were considered to form based on the journal. Cited relationships were used to indicate a feature of indegree centrality, namely links incoming from outside. High indegree centrality values indicates strong popularity. That is, the node strongly desires to be related from others. Outdegree centrality was used to indicate the times a journal cites another journal. In this case, the journals in the position reach out other related nodes. Closeness centrality evaluates how close a specific node is located to another node except for the node itself. In other words, the centrality of a node is measured by averaging the shortest distance between all nodes that are connected not only directly to a specific node but also indirectly in a network. Betweenness centrality is a method in which the role of mediators or arbitrators is evaluated based on their centrality in the network [9]. In particular, mediators or arbitrators are actors playing important roles in the information flow and exchange between all network members. Betweenness centrality shows that an individual actor plays a role as a mediator, arbitrator, or gatekeeper. Therefore, if a specific node is lost in the network structure, then it plays a role as an alternative path chosen by other institutions. Therefore, this centrality measure was used to grasp institutions that have the potential to influence their network activities. For the calculation and visualization of network centrality value and diagram, Ucinet [3] and [10] were used in this research.

## 4. RESULTS

### 4.1 Descriptive Statistic analysis

#### 4.1.1 Descriptive analysis based on publication productivity

To analyze the research question of how the production mode of EAR papers in Korea is formed, the trends in the publication of papers related to EAR and the characteristics of authors and their affiliations were examined. Fig. 1 shows the number of papers related to EAR and descriptive statistics. As shown in the figure, there was a sharp increase in the total number of papers from 317 in 2004 to 914 in 2013, reflecting a three-fold increase. However, an increase in the number of papers does not guarantee an increase in quality. Therefore, an additional analysis of citation data needs to be conducted. Fig. 1 also shows the number of both solely-authored and collaborative papers in addition to the total number of papers. The number of papers with sole authors increased from 228 in 2004 to 756 in 2013, closely reflecting the change in the total number of papers. The total number of collaborative papers was negligible and decreased from 2009. That is, EAR papers were more likely to be published by sole authors than by multiple authors.

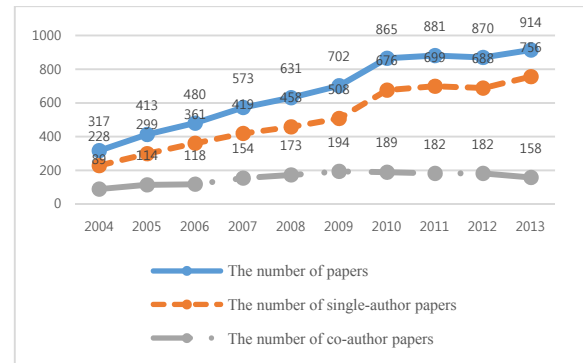


Fig. 1. The number of papers by year based on the type of authorship

#### 4.1.2 Descriptive analysis based on the number of authors

As discussed earlier concerning the number of papers, EAR papers were led by individual authors rather than team science. Fig. 2 provides more detailed results. The total number of authors has increased by about 2.2 times from 506 in 2004 to 1,226 in 2013. The number of coauthors slightly exceeded the number of single authors because the number of coauthors was the sum of all coauthors included in the collaborative papers. However, even this number of coauthors has decreased from 2009, indicating that papers with sole authors encompassed coauthored papers. This again implies that EAR papers were led by sole authors.

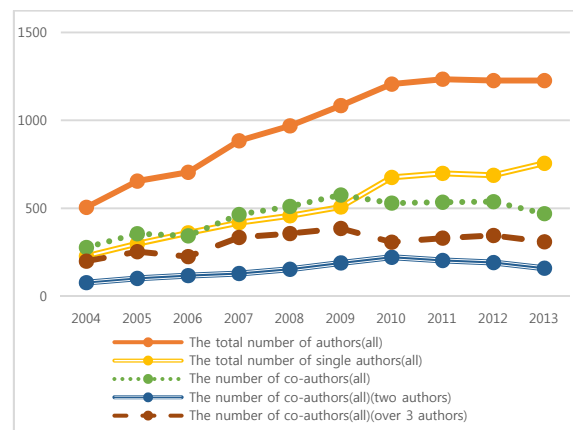


Fig. 2. The number of authors by year

#### 4.1.3 Descriptive analysis based on the number of institutions

Fig. 3 shows that the number of institutions dealing with EAR papers, which almost doubled from 502 in 2004 to 1,128 in 2013. Many universities and research institutions produced EAR papers. However, the total number of unique institutions was quite different. The number of unique institutions producing EAR papers has increased by about 1.8 times from 170 in 2004 to 322 in 2013. In addition, the number of institutions has been stagnant since 2009. This result may be associated with the negligible increase in the number of total papers since 2009 as discussed earlier.

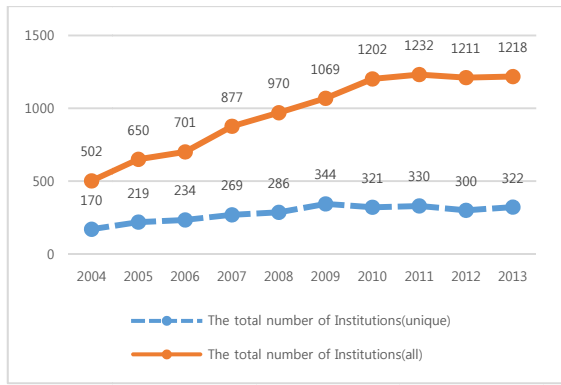


Fig. 3. The number of institutions by year

4.2 Social network analysis

4.2.1 The network of institutions

To investigate the second research question (how the network structure of EAR papers published in Korea formed), a matrix of collaborating institutions was constructed. The 2004-2013 period was divided into five 2-year subperiods for the collaborative network to investigate differences in characteristic features of co-institution networks. Table 1 summarizes these characteristics. A node indicates the number of institutions, and the “average path distance” value is used for the average of connecting stages which from a node to another node without stopping in the whole network. In addition, “centralization” value shows how connections exchanged within entire network are concentrated to central nodes. Density indicates how closely nodes are connected in general.

In networks of co-institutions, an increase in the number of nodes presents a growth in the number of various types of collaborative institutions. The number of co-institutions increased in recent years, but it decreased from 2010-2011 to 2012-2013. In general, the larger the number of nodes, the lower the density of the network was. Here the density of the network decreased until 2010-2011 and then increased in 2012-2013. The average path distance decreased in 2012-2013. Noteworthy is that the collaborative network decreased again recently. That is, the number of co-institutions increased until 2010-2011, but during 2012-2013, the number of co-institutions has decreased. On the other hand, in terms of the centralization tendency, the larger the number of nodes, the lower the centralization was. However, the centralization tendency increased abruptly in 2012-2013. In other words, the tendency to collaborate happened around specific institutions in 2012-2013, whereas it happened around various institutions in 2010-2011.

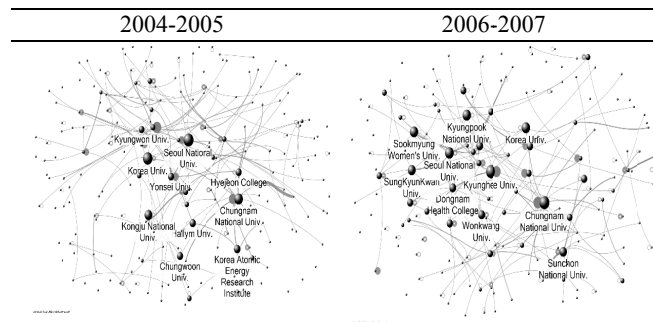
Table 1. Descriptive statistics for collaborative institutions

|                           | 2004-2005 | 2006-2007 | 2008-2009 | 2010-2011 | 2012-2013 |
|---------------------------|-----------|-----------|-----------|-----------|-----------|
| Nodes                     | 201       | 158       | 422       | 490       | 327       |
| Average geodesic distance | 4.60      | 4.69      | 5.09      | 5.71      | 5.00      |
| Centralization (%)        | 0.849     | 1.673     | 0.695     | 0.438     | 1.502     |
| Density                   | 0.0064    | 0.0109    | 0.0025    | 0.0018    | 0.0036    |

Fig. 4 shows the network of co-institutions through the mediation of papers over time. The network diagram was visualized using Nodexl, and the node was used to indicate institutions such that the larger the node, the higher the nodal betweenness centrality. The thickness of the line between nodes was used to indicate the number of collaborative relationships between two institutions. The visualization algorithm was the Fruchterman-Reingold force-directed layout. This layout was used to measure and visualize the strength of the relationship between two nodes, which usually appeared as a ring. The stronger the influence of a node, the more central the position of the node was. Only top 10 nodes in terms of their influence are shown for smooth visualization.

As shown in the figure, the network of co-institutions analyzed based on five subperiods becomes more complex in recent years. According to this network, the larger the node, the more central its position is in the network based on higher betweenness centrality. From this perspective, this network shows the network of institutions that Chungnam Univ., Korea Univ., and Seoul National Univ. frequently exchanged with during the 2004-2005 period. This means that these institutions mediated relationships between other institutions. Kyunghee Univ., Chungnam Univ., and Korea Univ. occupy central positions in 2006-2007. Among these, Kyunghee Univ. and Chungnam Univ. are shown a large node with grey circles, implying co-authorships within the same institution (self-loop) based on their collaboration. Seoul National Univ., Kangwon Univ., and Kyunghee Univ. are prominent nodes in 2008-2009, and the Rural Development Administration and Kongju Univ. are active co-institutions in 2010-2011. In 2012-2013, the Rural Development Administration, Kyungpook National Univ., and Kyunghee Univ. play active roles, occupying central positions. Kyunghee Univ. still shows a strong tendency to self-loop since they appeared at the center in 2006-2007. In addition, the appearance of the Rural Development Administration can be explained as a growing interdisciplinary characteristics of the EAR in its relevant research domain.

Based on the pattern of the whole network, nodes are sparsely connected to other nodes in 2008-2009, indicating the involvement of various institutions in this collaborative activity. By contrast, in 2006-2007 and 2012-2013, the whole network is not widely spread out. Instead, it is concentrated around specific institutions, implying collaborative activities during these periods to be led by those specific institutions. This is verified by the previous analysis of descriptive statistics for the network over time.





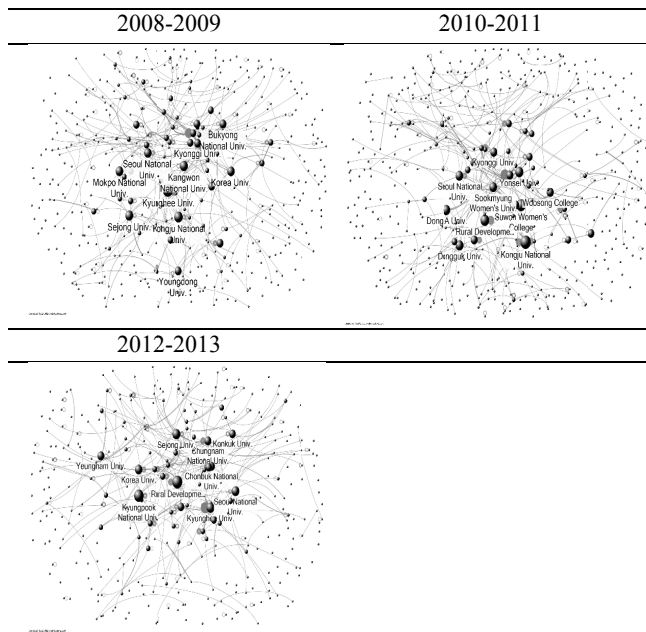


Fig. 4. Co-institution networks for the 2004-2013 period

Now the precise network value of institution networks mentioned earlier is discussed. Tables 2 and 3 show the changes of the network value for the top 10 institutions. Closeness centrality is ruled out from the analysis because of negligible differences between institutions.

Table 2. The degree centrality of institutions across periods

| 2004-2005                |                   | 2006-2007               |                   | 2008-2009               |                   | 2010-2011               |                   | 2012-2013                        |                   |
|--------------------------|-------------------|-------------------------|-------------------|-------------------------|-------------------|-------------------------|-------------------|----------------------------------|-------------------|
| Institution              | Degree centrality | Institution             | Degree centrality | Institution             | Degree centrality | Institution             | Degree centrality | Institution                      | Degree centrality |
| Wonkwang Univ.           | 13                | Chungnam National Univ. | 13                | Kyunghee Univ.          | 14                | Pusan National Univ.    | 11                | Chungnam National Univ.          | 13                |
| Yeungnam Univ.           | 11                | Kyunghee Univ.          | 12                | Sejong Univ.            | 13                | Kongju National Univ.   | 10                | Kyunghee Univ.                   | 12                |
| Chungnam National Univ.  | 10                | Sunchon National Univ.  | 10                | Korea Univ.             | 12                | Yonsei Univ.            | 10                | Seoul National Univ.             | 12                |
| Catholic Univ. of daegu  | 9                 | Hyejeon College         | 9                 | Kongju National Univ.   | 11                | Sookmyung Women's Univ. | 10                | Sejong Univ.                     | 11                |
| Kyunghee Univ.           | 9                 | Sookmyung Women's Univ. | 9                 | Chungnam National Univ. | 10                | Seoul National Univ.    | 10                | Korea Univ.                      | 11                |
| Seoul National Univ.     | 8                 | Joongbu Univ.           | 9                 | Kyonggi Univ.           | 10                | Dongguk Univ.           | 9                 | Rural Development Administration | 10                |
| Korea Univ.              | 8                 | Wonkwang Univ.          | 9                 | Catholic Univ. of daegu | 10                | Dong-A Univ.            | 9                 | Kyungpook National Univ.         | 10                |
| Kyungwoon Univ.          | 7                 | Seoul National Univ.    | 9                 | Chungbuk National Univ. | 9                 | Kyunghee Univ.          | 9                 | Chonbuk National Univ.           | 10                |
| Joongbu Univ.            | 7                 | Sejong Univ.            | 8                 | Yeungnam Univ.          | 9                 | Korea Univ.             | 9                 | Woosong Univ.                    | 9                 |
| Kyungpook National Univ. | 7                 | Daegu Technical Univ.   | 8                 | Seoul National Univ.    | 9                 | Kangwon National Univ.  | 9                 | Pusan National Univ.             | 9                 |

Table 3. The betweenness centrality of institutions across periods

| 2004-2005                              |                        | 2006-2007                |                        | 2008-2009              |                        | 2010-2011                        |                        | 2012-2013                        |                        |
|--|------------------------|--------------------------|------------------------|------------------------|------------------------|----------------------------------|------------------------|----------------------------------|------------------------|
| Institution                            | Betweenness centrality | Institution              | Betweenness centrality | Institution            | Betweenness centrality | Institution                      | Betweenness centrality | Institution                      | Betweenness centrality |
| Seoul National Univ.                   | 820.00                 | Kyunghee Univ.           | 1616.97                | Kyunghee Univ.         | 3384.35                | Kongju National Univ.            | 3807.81                | Rural Development Administration | 3519.73                |
| Korea Univ.                            | 747.00                 | Chungnam National Univ.  | 1485.34                | Kongju National Univ.  | 2390.24                | Suwon Women's College            | 3014.76                | Kyungpook National Univ.         | 3216.10                |
| Chungnam National Univ.                | 594.00                 | Seoul National Univ.     | 1149.10                | Kangwon National Univ. | 2108.48                | Rural Development Administration | 2630.23                | Sejong Univ.                     | 2255.52                |
| Kongju National Univ.                  | 488.00                 | kyungpook National Univ. | 1075.50                | Sejong Univ.           | 2047.00                | Yonsei Univ.                     | 2248.40                | Kyunghee Univ.                   | 2226.07                |
| Korea Atomic Energy Research Institute | 336.00                 | Korea Univ.              | 1060.97                | Mokpo National Univ.   | 1899.43                | Dongguk Univ.                    | 2165.03                | Seoul National Univ.             | 2038.51                |
| Institute of Chungcheong Univ.         | 301.00                 | Sookmyung Women's Univ.  | 1034.36                | Korea Univ.            | 1842.42                | Dong-A Univ.                     | 2157.96                | Korea Univ.                      | 1904.67                |
| Hallym Univ.                           | 301.00                 | SungKyunKwan Univ.       | 926.89                 | Seoul National Univ.   | 1800.74                | Sookmyung Women's Univ.          | 2020.83                | Yeungnam Univ.                   | 1627.06                |
| Yonsei Univ.                           | 273.00                 | Sunchon National Univ.   | 815.23                 | Bukyeon National Univ. | 1545.34                | Seoul National Univ.             | 2000.00                | Chonbuk National Univ.           | 1613.86                |
| Hyejeon College                        | 269.00                 | Wonkwang Univ.           | 697.00                 | Youngdong Univ.        | 1499.18                | Woosong College                  | 1727.51                | Chungnam National Univ.          | 1603.26                |
| Hallym Univ.                           | 264.00                 | DongnamHealth College    | 680.91                 | Kyonggi Univ.          | 1461.20                | Kyonggi Univ.                    | 1645.70                | Konkuk Univ.                     | 1524.43                |

For degree centrality and betweenness centrality across periods, those institutions with many co-institution relationships, in degree centrality, with other institutions in 2004-2005 included Wonkwang Univ., Yeungnam Univ., and Chungnam Univ., in that order. However, in betweenness centrality, the order was Seoul National Univ., Korea Univ., and Chungnam National Univ. This means Wonkwang Univ. had collaborated within institutions than with other institutions. On the other hand, in the case of Chungnam National Univ., both degree centrality and betweenness centrality were ranked at the top because they had many collaborative relationships within institutions as well as with other institutions. In terms of degree centrality in 2006-2007, the order was Chungnam National Univ., Kyunghee Univ., and Sunchon Univ., and in terms of betweenness centrality, it was Kyunghee Univ., Chungnam National Univ., and Seoul National Univ. Chungnam National Univ. and Kyunghee Univ. had many collaborative relationships not only within institutions but also with other institutions, and therefore both network values were high. In terms of degree centrality in 2008-2009, the order was Kyunghee Univ., Sejong Univ., and Korea Univ., in that order, and for betweenness centrality, it was Kyunghee Univ., Kongju Univ., and Kangwon National Univ. For degree centrality in 2010-2011, the order was Pusan National Univ., Kongju National Univ., and Yonsei Univ., in that order, and for betweenness centrality, it was Kongju National Univ., Suwon



betweenness centrality in the co-institution network because it focused more on intra-institutional collaboration research rather than on forming collaborative networks with other institutions. More recently, however, Kyunghee Univ. showed almost equal degree centrality and betweenness centrality. This implies that it progressed actively toward collaboration not only within the institution but also with other institutions. Although the Rural Development Administration appeared far away from EAR scholarship, it showed the highest degree centrality as well as betweenness centrality, indicating its active production of papers in the EAR-relevant area.

After core journals in ERA were selected based on citation performance, a citation network among them was constructed. Noteworthy is that the main discipline of journals about EAR were led by "History" and "Korean with literature" based on KCI subcategories. Although "Chinese with literature" and "Japanese with literature" formed citation networks, they were relatively insignificant. In addition, "life science" in the *Journal of East Asian Society of Dietary Life*, previously regarded to play a main role in institution networks, had a relationship with EAR through a citation relationship with "Social Science."

This study quantitatively analyzes the intellectual structure of EAR, which has become a mainstream field of research in various aspects since the 1990s. As demonstrated by the number of papers, EAR has matured rapidly. Given this background, [20] stated that research support by the NRF of Korea had a considerable impact on the field by boosting and expanding EAR. More specifically, from 1999 to 2006, a fifth of university research centers that received a big grant from the NRF of Korea fall in the category of EAR. Furthermore, the selection rate of EAR research proposals in the competition of basic research projects has remained high since 2000. In addition, with the spread of the "Korean wave," an international research boom in East Asian cultures has affected a wide range of fields such as politics, the economy, and diplomacy in EAR [43]. This view of the expansion of EAR may be triggered not by some internal anguish but by an external cause, which implies that the field is still growing. Although this growth is due to external causes, it is fair to say that the dazzling growth of EAR in various academic areas since 2000 reflects spontaneousness more than external support.

The limitations of the current study may be critical. In this study, only academic papers were considered. Future studies need to be conducted from diverse perspectives, using new digital media [37], [41], [42]. Another limitation is that this study employed a quantitative method to analyze the data. When interpreting the results in regard to citation network of journals, we need to consider qualitative contexts. In order to go beyond the bounds of Korean research area, EAR needs to be extended to new digital media scholarship and qualitative method.

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