

## *Collaboration network of applied linguistics research articles with different methodological orientations*

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### Abstract

The current study draws on synthetic techniques and bibliometric analysis to explore the patterns of scientific collaboration in light of methodological orientations. We examined 3,992 applied linguistics (AL) articles published in 18 top-tier journals from 2009 to 2018 and analyzed their methodological orientations and scientific collaboration. Considering that the number of co-authored papers outweighs single-authored counterparts, our results revealed that the overall degree of collaboration for AL journals was moderate-to-high (57.7%). In particular, quantitative studies contained the highest degree of collaboration (66.8%). This was followed by systematic reviews (60.9%), and mixed-methods approach (55.7%). Country-wise, our overall findings further indicated that the United States and the United Kingdom were the two main hubs of collaborative activities for quantitative, qualitative, and mixed-methods research. While the USA was the top country in systematic reviews like all other research approaches, the UK was the fifth country in systematic reviews. As for collaborating authors, our findings demonstrated that the most influential quantitative researchers had collaborated on Natural Language Processing (NLP) and data mining. While the mixed-methods researchers had a tendency to collaborate on conceptual issues subscribing to the language testing and assessment strand,

the most productive qualitative researchers had collaborated on L2 writing issues. Implications for applied linguistics research are further discussed.

*Keywords:* applied linguistics; bibliometric analysis; collaboration network; methodological orientations

## 1. Introduction

Nowadays, research in the field of applied linguistics (AL), which flies under the banners of “methodological awareness” (Plonsky, 2017, p. 517), “methodological turn” (Byrnes, 2013, p. 825), and “meta-research era” (Amini Farsani et al., 2021, p. 2), is blooming in a multitude of directions (e.g., research quality, research transparency, data-mining, statistical literacy, and methodological orientations). Concomitantly, a layering approach, as proposed by King and Mackey (2016, p. 223) to deal *collaboratively* with L2 real-world and complex L2 problems through “distinct epistemological perspectives,” underpins the rise of research methodology, which is, in turn, oriented toward “pushing methodological boundaries to gain a clearer picture and deeper insights into the process of second language learning” (p. 212).

Accordingly, such recent research advancements in applied linguistics have given rise to the birth of “a golden age of applied linguistics research” (McKinley, 2020, p. 1), wherein applied linguists – through multi- and interdisciplinary *collaborative* dialogue (Amini Farsani et al., 2021; King & Mackey, 2016) – are seeking to boost the field through improving research quality, enhancing research transparency, and sharing knowledge effectively. In King and Mackey’s words, “applied linguistics is at its best when focused squarely on solving problems of language learning” (2016, p. 223).

The expanding scope of research trends and methodological advancements along with dissemination of voluminous publications in different strands of applied linguistics (i.e., language learning, language testing, language learning and technology, language planning and policy) has brought about an “explosion in quantity and quality of applied linguistics research” (McKinley, 2020, p. 1). This growing scope of applied linguistics research necessitates a call for bibliometrics, a field of study which is characterized as “the application of mathematical and statistical methods to books and other means of communications” (Pritchard, 1969, p. 349).

Applied bibliometrics, that is, the application of bibliometric techniques to examine aspects of a research domain (Amini Farsani et al., 2021), helps applied linguists to trace the quality and quantity of research outputs and explore

a cumulative and chronological trend of research in terms of keywords, academic citation and co-citations (e.g., highly-cited authors, countries, institutes), and patterns of co-authorships networks and scientific collaborations (Lei & Liu, 2019; Zhang, 2020). For example, employing bibliometric techniques, Lei and Liu (2019) examined research trends in applied linguistics by surveying the prevalent research topics, highly cited publications, highly cited authors, and the most productive countries and regions. Likewise, Zhang (2020) explored the research trends of second language acquisition (SLA) between 1997 and 2018 through bibliometric indicators such as (co-)citation analysis and keyword analysis.

These studies provide examples for the use of bibliometric indicators (i.e., keyword analysis, citation analysis) to survey cumulatively and chronologically research trends in the field. However, what they probably fail to highlight is the notion of scientific collaboration as one of the most important means of enhancing the quality of science and of promoting collaborative competence (Letsky et al., 2008). As McKinley (2020) puts it, the expansion of scope in applied linguistics research is highly dependent on the dialogue of applied linguistics with other disciplines such as politics, business, medicine, and science. Likewise, Amini Farsani et al. (2021), adhering to methodological synthesis and bibliometric analysis, examined scientific collaborations, as represented by co-authorships, of applied linguistics articles disseminated in the leading journals. The results revealed that applied linguists have collaborated with different disciplines such as educational studies (38.35%), life sciences (33.44%), physical sciences (13.88%), social sciences (4.1%), and arts and humanities (1.64%).

Empirical studies on scientific collaboration in various hard and soft sciences are increasing at an unprecedented rate. However, the rise of collaborative-inspired studies has been scattered unevenly for different disciplines (Gazni et al., 2011; Nikzad et al., 2011; Sonnenwald, 2007). In particular, there exists a growing tendency to collaborate in social sciences; however, this tendency to collaborate on research projects decreases in the field of arts and humanities (Hilario & Grácio, 2017).

The orientations of researchers promoting the collaborative-inspired studies have also been different (Amini Farsani et al., 2021; Boschma, 2005; Gazni et al., 2011; Sonnenwald, 2007). Their foci have included *disciplinary collaboration* (i.e., inter-, intra-, and multidisciplinary collaboration), *geographic collaboration* (i.e., international and domestic collaboration), *organizational* and *community collaboration* (i.e., university-industry collaboration and academic-industry collaboration), *institutional collaboration* (department collaboration), and *socioeconomic collaboration*.

Although the above foci and orientations underscore their contributory role in shaping collaborative competence among researchers, there is a paucity

of empirical investigations into the pattern of collaboration at the levels of authors, countries, and institutions across methodological orientations (i.e., quantitative, qualitative, mixed-methods research; systematic reviews; see also Amini Farsani et al., 2021). Considering the role task complexity has played in collaborations (Harkins & Petty, 1982), the main thrust of our argument is that some methodological orientations, due to their ontological and epistemological assumptions, need more collaboration between and among researchers than others. For example, considering the necessity of quantitative and qualitative cognitive and declarative knowledge for conducting mixed-methods research (MMR), it seems that MMR studies, which necessarily examine multifaceted and complex conceptual issues (e.g., L2 problems), should embrace more researchers and collaborators than mono-methods such as quantitative and qualitative research paradigms (Onwuegbuzie et al., 2018).

Furthermore, as Guetterman (2017) asserts, collaboration is one of the most important personal characteristics in shaping mixed-methods research proficiency. As such, examining applied linguists' mixed methods research proficiency, Amini Farsani et al. (2022) explored the most frequently represented characteristics of applied linguists: "collaborating with others," "using multiple sources," "thinking creatively," "welcoming dissimilar views," and "team working." This recent empirical finding echoes the role collaboration and teamwork have played in shaping MMR studies. In Hashemi's (2020) words, to carry out an MMR project, "researchers from different research backgrounds work together as a team to design and implement a study" (p. 48).

The centrality of methodological orientations is relatively further established for systematic reviews, which have received a bigger citation impact than quantitative, qualitative, and mixed-methods research studies (Amini Farsani et al., 2021). In order to conduct different forms of systematic reviews (i.e., meta-analysis, methodological synthesis, second-order research synthesis), reviewers should promote dialogs and collaborations with other researchers to shape objective and compelling systematic reviews. In particular, in conducting meta-analytic studies, it is necessary to have a group of experts in conceptual and methodological issues, which necessitates more collaboration (Cooper, 2016).

The above methodological orientations, which are relatively tailored to the layering approach to deal with multi-aspectual and complex L2 problems (King & Mackey, 2016), might underscore the role of *cognitive proximity* in influencing scientific collaboration. The presupposition of cognitive proximity, as Boschma (2005) puts it, is that knowledge creation and innovations are often cumulative and supplementary, which in turn needs a high degree of collaboration. For this reason, "the capacity of actors to absorb new knowledge requires cognitive proximity" (p. 63). These two methodological orientations (i.e., systematic reviews and mixed-methods research) can be collaboratively considered from the lens of

*cognitive proximity*, wherein the individuals (here collaborators on mixed methods research and systematic reviews) have close knowledge, such as research expertise, academic formation, and the same work field (Boschma, 2005).

The main argument made here, which has been subsumed under the layering approach and cognitive proximity, is that there exists a potential for mixed-methods researchers and systematic reviewers to address their challenges through collaboration. As such, these researchers with supplementary levels of expertise, including conceptual and (quantitative and qualitative) methodological specialists, jointly identify the demands of different topics and develop coherently collaborative strategies to meet the needs of L2 multifaceted and complicated problems.

Situating scientific collaboration in methodological orientations, Onwuegbuzie and his colleagues, in a few studies, have recently documented such cross-breeding of scientific collaboration and methodological orientations, which give rise to what we call *methodological proximity*. Following a mixed-methods bibliometric approach, Onwuegbuzie et al. (2018) examined the degree of collaboration in 1,553 articles published in six multidisciplinary journals, each with different methodological orientations from 2007 to 2014. The corpus consisted of: (1) two mixed-methods research journals ( $N = 263$ ) (i.e., *Journal of Mixed Methods Research* and *International Journal of Multiple Research Approaches*); (2) two quantitative research journals ( $N = 481$ ) (i.e., *Journal of Applied Quantitative Methods*; *Journal of Educational and Behavioral Statistics*); and (3) two qualitative research journals ( $N = 789$ ) (*Qualitative Report*; *International Journal of Qualitative Methods*). The quantitative and qualitative findings revealed that “more collaboration occurs among mixed researchers than among quantitative and, especially, qualitative researchers – at least as represented by the two select quantitative research journals and qualitative research journals” (Onwuegbuzie et al., 2018, p. 453).

Likewise, Wachsmann et al. (2019), taking a mixed-methods bibliometric approach, compared more experienced and less experienced researchers and their collaborative behaviors in 223 articles published in the top-tier *Journal of Mixed Methods Research* from 2007 to 2018. The results revealed that a great portion of the studies (69.5%) involved more than one author, “which yielded the degree of collaboration” (p. 2964). About 42% of the studies included either two or three authors. The results further indicated no significant difference between more-experienced and less-experienced collaborators in MMR studies. Accordingly, the overall findings provide compelling evidence for practicing higher collaboration in mixed-methods studies. Furthermore, mixed methods research teams appear to “comprise a similar proportion of leading researchers/authors with *more* research experience and researchers/authors with *less* research experience” (Wachsmann et al., 2019, p. 2973).

Although these studies provide clear evidence for practicing a higher degree of collaboration among mixed methods researchers than in the case of

mono-method (i.e., quantitative or qualitative) counterparts, Onwuegbuzie and his colleagues, adhering to mixed methods bibliometric approach, have covered a range of different disciplines (e.g., health, education, psychology, management, and business), which in turn might impose epistemological and ontological tendency to collaborative patterns. Likewise, disciplinary variations can influence the paths through which knowledge is transferred, communicated, and presented to its target consumers (Becher & Trowler, 2001).

Although the centrality of methodological orientations is established, more context-specific collaborative studies at different collaborative levels are needed (Amini Farsani et al., 2021; Gazni et al., 2011). As such, if one needs to understand collaborative competence and team cognition in different research methods, one must understand how collaboration is practiced at different levels. In the field of applied linguistics, this translates into implementing collaborative-inspired studies for addressing L2 problems at different levels of authors, institutions, and countries. However, there exists little or no empirical information about the scientific collaboration of researchers with quantitative, qualitative, mixed-methods, and systematic reviews orientations in different disciplines in general and in applied linguistics in particular (Amini Farsani et al., 2021; Onwuegbuzie et al., 2018).

Accordingly, this study, adhering to bibliometric and synthetic techniques, seeks to bridge this gap by examining scientific collaboration in light of methodological orientations at different levels (i.e., authors, institutions, and countries) from 2009 to 2018. The following research questions are addressed:

- RQ1: What is the degree of collaboration in articles published in applied linguistics journals?
- RQ2: To what extent is the degree of collaboration different in quantitative, qualitative, mixed methods, and systematic reviews?
- RQ3: To what extent is regional collaboration different in quantitative, qualitative, mixed methods, and systematic reviews?
- RQ4: What are the most influential authors in quantitative, qualitative, mixed-methods, and systematic reviews in terms of collaboration and citation?
- RQ5: What are the collaborative patterns among countries in terms of their economic and scientific status?

## 2. Method

The current study, adopting a synergy of research synthetic techniques and bibliometric approach, is a part of a larger bibliometric project in which various forms of bibliometric indicators (i.e., citation analysis, keyword analysis, and collaboration)

in light of methodological orientations (i.e., quantitative, qualitative, mixed-methods research, and systematic reviews) have been examined to explore the “intellectual structure” of the field of applied linguistics over a decade from 2009 to 2018 (Zhang, 2020, p. 200). The scope of this study is delimited to the alignment of scientific collaboration and methodological orientations in the field. In this study, we followed the research synthesis approach in terms of article identification and retrieval, data set coding procedures, and data analysis (Plonsky, 2013, 2014).

## 2.1. Article identification and retrieval

The initial phase in synthesizing the current study was to identify and locate the domain of primary studies within applied linguistics. Following Plonsky (2013, 2014), the domain was operationalized into three components, including *location*, *time*, and *content*. Location-wise, the current study used the articles disseminated in the top-tier applied linguistics journals. We used the sampling procedures proposed by Amini Farsani et al. (2021) and came up with 18 leading journals of applied linguistics. In particular, we employed a triple sampling scheme based on: (a) the list of representative journals proposed by Lei and Liu (2019); (b) Alise and Teddlie's (2010) procedures in selecting top-tier journals; and (c) expert judgments. Applying the multilayer sampling procedures (Alise & Teddlie, 2010), we came up with the following journals: *Language Learning*, *Applied Linguistics*, *Studies in Second Language Acquisition*, *Modern Language Journal*, *TESOL Quarterly*, *Computer Assisted Language Learning*, *Language Teaching Research*, *System*, *Language Learning & Technology*, *ReCALL*, *Language Testing*, *Second Language Research*, *Journal of Second Language Writing*, *Foreign Language Annals*, *Journal of English for Academic Purposes*, *English for Specific Purposes*, *Assessing Writing*, and *Language Assessment Quarterly*. Furthermore, we selected the quantitative, qualitative, mixed methods research studies, and systematic reviews published in the above journals over a recent decade from 2009 to 2018 inclusive. Therefore, applying exclusion and inclusion criteria and based on the above criteria (location, time, and content), we came up with 3,992 articles.

## 2.2. Coding

In this phase, we modified the instrument developed by Amini Farsani et al. (2021), which was originally designed based on the guidelines provided in the literature (Cooper, 2016; Plonsky, 2013). This original instrument consisted of the following categories: (a) study description, (b) methodological orientations, (c) research designs, and (d) disciplinary collaboration patterns. We have made the

data available on Figshare.<sup>1</sup> For the purpose of the study, we modified the original instrument and added economic and scientific collaboration patterns. Research designs and disciplinary collaboration patterns were not accounted for here.

Applying a manual strategy, we classified the 3,992 articles as non-empirical, quantitative, qualitative, mixed methods, and systematic reviews (Amini Farsani et al., 2021). The designation of scientific and economic collaborations was further determined by parameters set by Wagner et al. (2001) and the report disseminated by World Bank (2019), respectively. Scientifically, Wagner et al. (2001) categorized countries based on four distinct classes, including scientifically advanced countries (SAC), scientifically proficient countries (SPC), scientifically developing countries (SDC), and scientifically lagging countries (SLC). Economically, the World Bank divided the countries into high income, upper-middle income, lower-middle income, and low income (World Bank, 2019). The inter-rater reliability (using percent agreement procedures) was reported here as .88. For economic and scientific collaboration, the reliability was reported as .96. In case of any discrepancies, the raters discussed the challenging issues until they reached an agreed-upon decision.

### 2.3. Bibliographic and data analysis

Bibliographic information for all papers was retrieved from the Scopus database and was subjected to country and individual co-authorship analysis using VOSviewer software (Van Eck & Waltman, 2010). The country collaboration networks for each method were created only for countries with at least five articles in the data, except for non-empirical and review papers. In the case of these two methods, due to their small dataset, any country with at least one paper was included in the network analysis. The networks below only show the countries that have some links and isolated countries that have been excluded from the diagrams. The software was also used to create a visualization of collaboration networks. We further estimated the degree of collaboration (DC) through the formula proposed by Subramanyam (1983):  $DC = \text{number of multiple-authored papers published in a given period of time} / \text{total number of papers published in the given period of time}$ .

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<sup>1</sup> Following the open science mantra, the coding sheet and coding manual, which includes the coding procedures and agreed-upon decisions, will be shared on the IRIS depository (<https://www.iris-database.org>).



### 3. Results

An analysis of the 3,992 articles published in 18 applied linguistics journals from 2009 to 2018 revealed that the number of authors per manuscript ranged from 1 to 16 ( $M = 1.9$ ,  $SD = 1.1$ ). As shown in Table 1, our findings reveal that the number of co-authored papers ( $N = 2302$ , 58%) outweighs those single-authored counterparts ( $N = 1690$ , 42.3%). Whereas 42.3% of articles involved one author (i.e., a non-collaborative batch), 35% involved two authors, 15% involved three, 5% involved four authors, and 2.75% involved five or more authors (i.e., a collaborative batch).

Our results further show the overall degree of collaboration for each research approach of the applied linguistics (AL) journals (see Table 1). The overall degree of collaboration for AL journals was moderate-to-high (57.7%). For empirical studies, in particular, quantitative studies contained the highest degree of collaboration (66.8%). This was followed by systematic reviews (60.9%), mixed-method approach (55.7%), and qualitative approach (45.5%). The difference between the degree of collaboration and research approaches was statistically significant ( $X^2 = 127$ ,  $df = 4$ ,  $p < .001$ ).

Table 1 AL publication rate and degree of collaboration for each research methods ( $N = 3992$ )

	Single authored-papers <i>N</i> (%)	Co-authored papers <i>N</i> (%)	DC <sup>1</sup> (%)	<i>M</i>	<i>SD</i>
Quantitative approach	564 (14.12%)	1136 (28.45%)	66.8	2.2	1.3
Qualitative approach	541 (13.55%)	452 (11.32%)	45.5	1.6	0.8
Mixed-methods approach	459 (11.49%)	575 (14.40%)	55.7	1.8	1
Systematic reviews	34 (0.85%)	53 (1.32%)	60.9	2	1.1
Non-empirical studies	92 (2.30%)	86 (2.15%)	48.3	1.7	1.1
Total	1690 (42.33%)	2302 (57.66%)	57.7	1.9	1.1

Note. 1 = Degree of collaboration based on the formula proposed by Subramanyam (1983)

#### 3.1. Country collaboration by research approach

##### 3.1.1. Country collaborators in quantitative research

The overall results revealed that the United States and the United Kingdom have the most productive quantitative researchers and have more collaboration with other countries, as indicated by their total link strength (see Table 2). Figure 1 illustrates the mapping of the collaboration network of countries by quantitative research approach. Generally, it seems English-speaking countries (USA, UK, Australia, Canada, and New Zealand) are well connected in the collaboration network. It depicts the three most frequently represented clusters. The first cluster (represented by red color), mainly comprised of countries in the (South) Eastern Asian regions, represents

the collaboration profile of the *Greater China* area, which is a geographical proxy that shares cultural and commercial relations (Harding, 1993). Apart from Saudi Arabia and Australia, all countries in the second cluster (represented in green color) are from European countries (mainly from the Scandinavian countries). The third cluster consists of Belgium, Netherlands, South Africa, and Switzerland.

Table 2 The most productive collaborators in quantitative research approach

Rank	Countries	Number of articles	Total link strength
1	United States	744	172
2	United Kingdom	195	111
3	Japan	114	49
4	Canada	113	60
5	Taiwan	91	22
6	China	85	68
7	Netherlands	75	37
8	New Zealand	70	43
9	Australia	64	43
10	Spain	59	21
11	Iran	50	8
12	Hong Kong	49	31
13	Germany	47	23
14	Turkey	35	12
15	Sweden	22	11

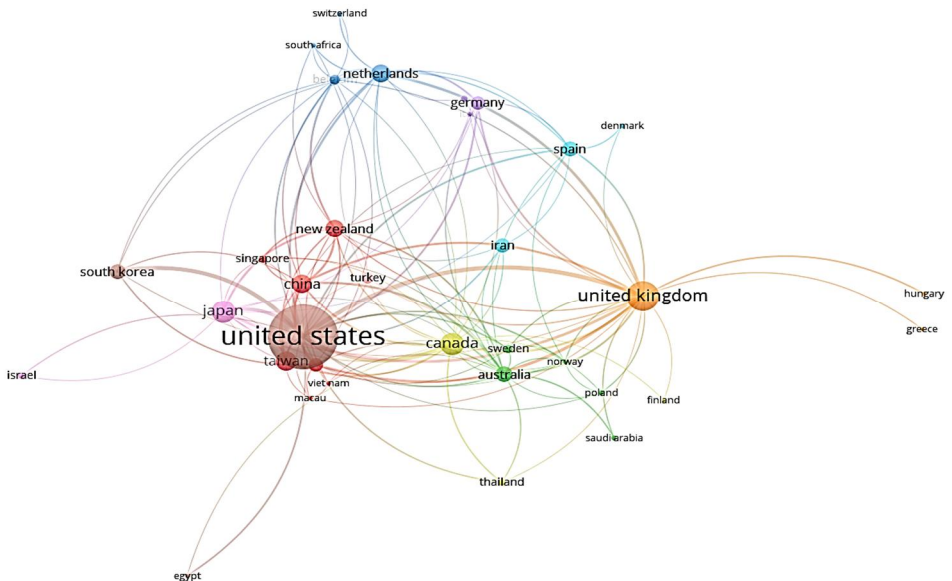


Figure 1 Collaboration map of countries with five or more articles in the quantitative research approach

### 3.1.2. Country collaborators in mixed-method research approach

As shown in Table 3 and Figure 2, similar to the quantitative results, the US and the UK are the two top productive and collaborative countries in the mixed-methods research approach. Notably, Iran and Turkey – two developing Asian countries – show a remarkably collaborative leap with other countries as represented in the following frequently represented clusters. The first cluster (represented in blue color) includes the UK, Japan, Turkey, and Germany. The second cluster (represented in green color) is *mainly* comprised of the collaboration between Asian (Iran and Singapore) and Oceanian countries (Australia and New Zealand). Apart from Taiwan, all countries in the third cluster (represented in red color) are from European countries.

Table 3 The most productive collaborators in a mixed-methods research approach

Rank	Countries	Number of articles	Total link strength
1	United States	343	54
2	United Kingdom	119	39
3	Taiwan	81	12
4	China	77	49
5	Hong Kong	63	19
6	Canada	62	17
7	Japan	55	22
8	Australia	54	16
9	Spain	38	7
10	New Zealand	31	20
11	Iran	30	1
12	South Korea	28	13
13	Spain	28	7
14	Sweden	28	5
15	Turkey	26	5

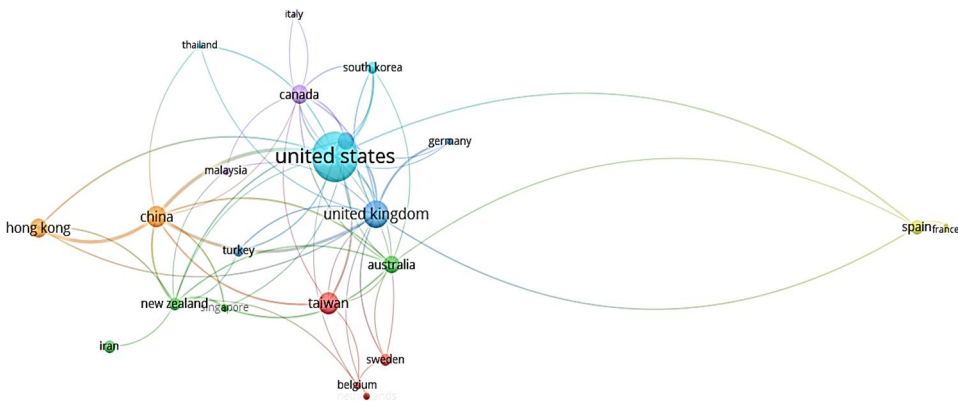


Figure 2 Collaboration map of countries with five or more articles in mixed-methods research approach

### 3.1.3. Country collaborators in qualitative research approach

In qualitative research (Table 4 and Figure 3), the US and the UK are again the top countries in terms of the number of papers and collaboration rate. The map further reflects the geographical proximity of the collaborators and identifies two frequently represented collaborative clusters. Apart from France, the first cluster (represented by red color) mainly consists of the collaboration of the Northern European region (i.e., Finland, Ireland, Norway, Sweden, and the UK). The second cluster, comprising of East Asian countries such as China, Hong Kong, Macau, and Singapore, represents the collaboration profile of the Greater China area.

Table 4 The most productive collaborators in qualitative research approach

Rank	Countries	Number of articles	Total link strength
1	United States	359	57
2	United Kingdom	114	37
3	Australia	83	27
4	Hong Kong	79	26
5	China	61	30
6	Taiwan	48	14
7	Canada	47	14
8	New Zealand	46	7
9	Japan	39	12
10	Spain	31	8
11	South Korea	26	11
12	Sweden	25	8
13	Turkey	15	5
14	Iran	15	4
15	France	15	1

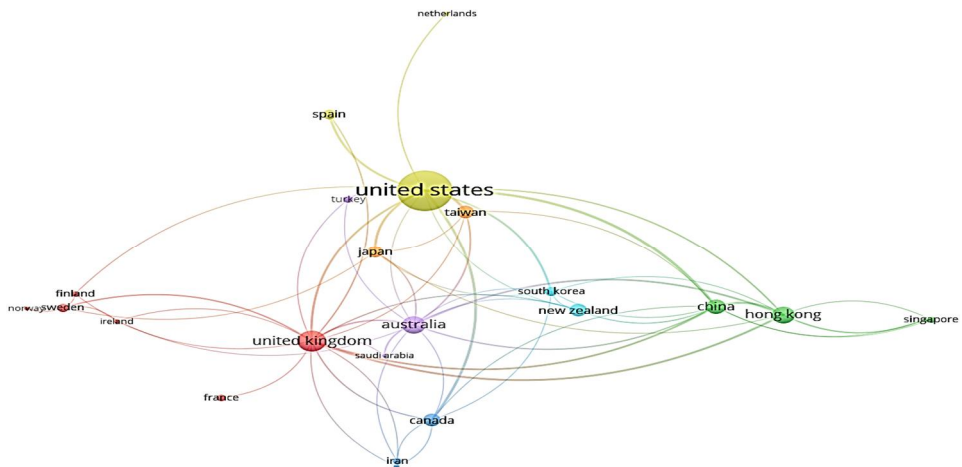


Figure 3 Collaboration map of countries with five or more articles in qualitative research approach

### 3.1.4. Country collaborators in systematic reviews

While the US is the top country in systematic reviews (Table 5 and Figure 4) like all other research approaches, the UK is the fifth country in systematic reviews. It seems that the second most productive reviewers are related to the Non-Anglo countries (i.e., Taiwan, Japan, and Iran), notably those located in the Asian region. Our findings further depict the two most frequently represented clusters. The first cluster (represented in red color) consists of the collaboration between the English-speaking countries (Australia and Canada) and the Southern Asian countries (China and Taiwan). The second cluster is the collaboration between Asian countries such as Iran and South Korea with the US, which plays a key role in shaping systematic studies (see Figure 4).

Table 5 The most productive collaborators in systematic review approach

Rank	Countries	Number of articles	Total link strength
1	United States	44	11
2	Taiwan	9	3
3	Japan	9	2
4	Canada	7	3
5	UK	7	3
6	Australia	3	2
7	Iran	3	1
8	China	2	2
9	South Korea	1	1
10	Spain	1	1
11	Thailand	1	1

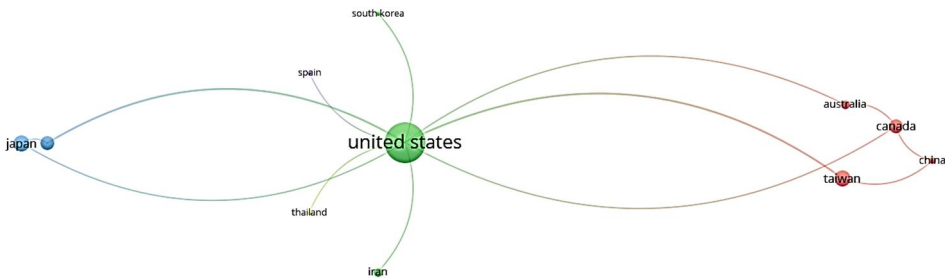


Figure 4 Collaboration map of countries in systematic review approach

### 3.2. Country collaboration based on scientific and economic status

Besides reporting collaboration by research methods, we also examined the scientific (see Wagner et al., 2001) and economic (see World Bank classifications) rate of collaboration among countries. Figure 5 illustrates the rate of scientific collaboration

among the four batches of countries, including SACs (scientifically advanced countries), SPCs (scientifically proficient countries), SDCs (scientifically developing countries), and SLCs (scientifically lagging countries). Our overall findings revealed that most collaboration happens between different SAC countries (green part in bars). The second most prevalent type of collaboration is between SAC and SPC countries (orange part), and the third most common is between SAC and SDC countries. SAC countries overall appear to act as the hub of international scientific collaboration for all research approaches. Furthermore, frequency ranking for the collaborative counterparts for quantitative, qualitative, mixed-methods research, and systematic reviews is in this order: SAC > SAC-SPC > SAC-SDS > SAC-SLC. Notably, the collaborative pattern of SLC-SPC for systematic reviews was represented more frequently than for other research approaches.

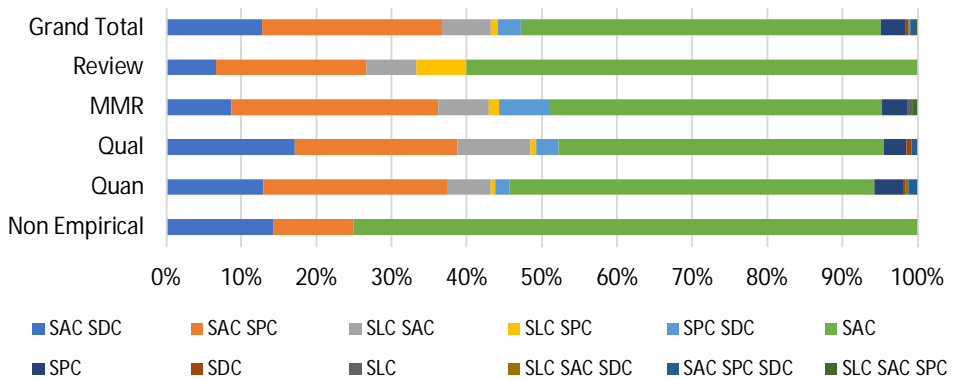


Figure 5 Scientific collaboration among the countries by research approaches

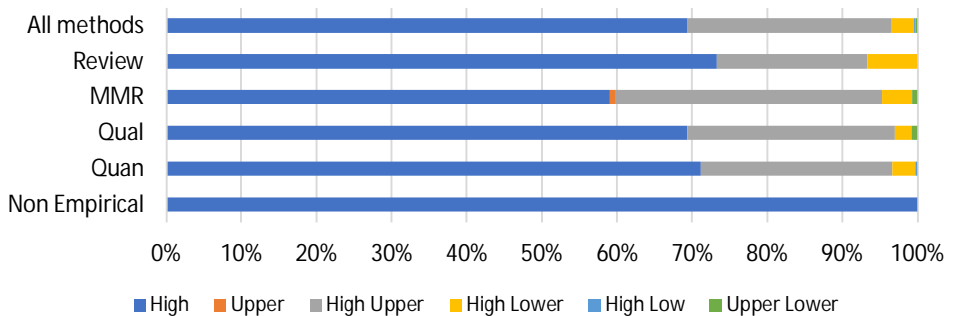


Figure 6 Economic collaboration among the countries by research approaches (high alone means countries with high income have collaborated with one another and so on)

Figure 6 depicts the rate of economic collaboration among the countries with high-income, upper-middle income, lower-middle income, and low income. Our findings showed that in all research approaches and overall, the most collaboration is between high-income countries (blue part of bars). The second most common type of collaboration is between high-income countries and upper-middle countries (red part). Other types of collaboration are scarce.

### 3.3. Author collaboration by research approach

#### 3.3.1. Author collaboration by quantitative research

Our overall findings extracted 21 clusters representing groups of authors who have collaborated more with one another (see Figure 7). The most frequently represented clusters cover second language acquisition (SLA) or instructed second language acquisition (ISLA) strands such as cognitive processing, input processing, affective factors, individual differences, and social factors. As shown in Table 6, considering the number of publications, the strength of collaboration (as represented in total link strength), and the number of citations, we found the most eminent/productive quantitative researchers are those applied linguists who have directly (i.e., Scott Crossley and Danielle McNamara<sup>2</sup>) or indirectly (i.e., Stuart Webb) worked on Artificial Intelligence (AI) in L2 with specific concentration on natural language processing (NLP) and data mining (e.g., the use of corpus linguistics in SLA). On the other hand, other (I)SLA-inspired researchers have contributed to the field of applied linguistics through a quantitative research approach (e.g., Kazuya Saito, Judit Kormos, and Norbert Schmitt).

Table 6 A profile of the 10 most eminent collaborators in quantitative research approach

Rank	Author	Number of publications	Total link strength	Citation	Average norm citations
1	Crossley, S.	21	38	685	1.82
2	Saito, K.	17	25	558	2.63
3	Webb, S.	15	21	646	2.20
4	Kim, Y.	14	21	346	1.33
5	Mcnamara, D.	13	26	552	1.96
6	Kormos, J.	11	14	486	2.13
7	Lee, J.	11	21	209	1.94
8	Zhang, L.	11	28	266	1.32
9	Boers, F.	10	24	271	1.60
10	Peters, E.	10	16	368	2.83

<sup>2</sup> To find their lines of research, we looked at their papers and academic webpage.

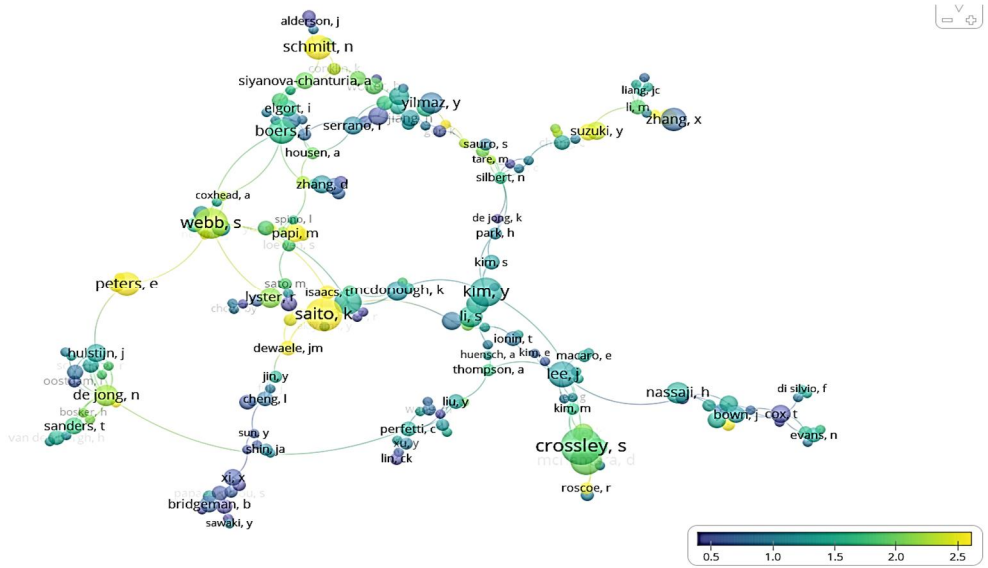


Figure 7 Collaboration map of authors with two or more articles in quantitative research approach

### 3.3.2. Author collaboration by mixed-methods research

As for mixed-methods collaborators, we identified six different clusters (Figure 8). Language testing and assessment and educational technology are among the most frequently represented strands in the clusters. As shown in Table 7, Paula Winke, as the most productive, influential, and collaborative researcher, has mainly used mixed-methods research to deal with the issues in the language testing and assessment strand.

Table 7 A profile of the 10 most eminent collaborators in mixed-methods research approach

Rank	Author	Number of publications	Total link strength	Citation	Average norm citations
1	Winke, P.	11	17	396	1.24
2	Kissau, S.	11	11	85	0.43
3	Lee, J.	9	10	204	1.13
4	Yang, Y-F.	8	4	147	0.90
5	Jiang, F.	7	7	118	1.73
6	Lee, L.	6	1	302	1.78
7	Algozzine, B.	5	7	37	0.41
8	Chen, H. J.	5	4	90	0.74
9	Hu, G.	5	4	163	1.71
10	Hyland, K.	5	4	120	2.13



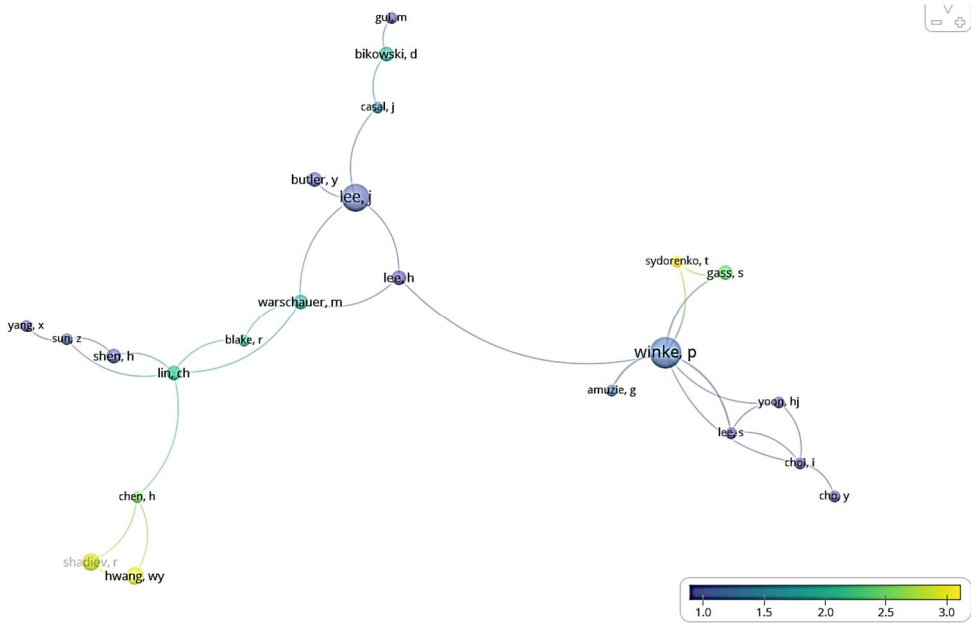


Figure 8 Collaboration map of authors with two or more articles in mixed-methods research approach

### 3.3.3. Author collaboration by qualitative research approach

Our overall findings extracted four clusters that represent groups of qualitative researchers who have collaborated more with one another (Figure 9). Apart from Kristin Davin, who does work related to Vygotskian sociocultural theory in L2 and second language development and assessment, our findings, as shown in Table 8, revealed that the most influential qualitative researchers (i.e., Icy Lee, Ken Hyland, Amanda Kibler, and Mimi Lee) are those applied linguistics who have collaborated on different strands of second language writing such as academic writing, the interface of writing and discourse, and writing literacy.

Table 8 A profile of the ten most eminent collaborators in qualitative research approach

Rank	Author	Number of publications	Total link strength	Citation	Average norm citations
1	Davin, K.	7	8	97	1.19
2	Lee, I.	7	5	234	1.79
3	Hyland, K.	6	4	227	2.78
4	Kibler, A.	6	8	73	0.77
5	Li, M.	6	8	203	2.23
6	Dooly, M.	5	4	113	1.27
7	Eskildsen, S.	5	4	217	2.21
8	Guichon, N.	5	5	146	0.89
9	Kim, H.	5	1	47	0.63
10	Kuteeva, M.	5	5	87	0.89

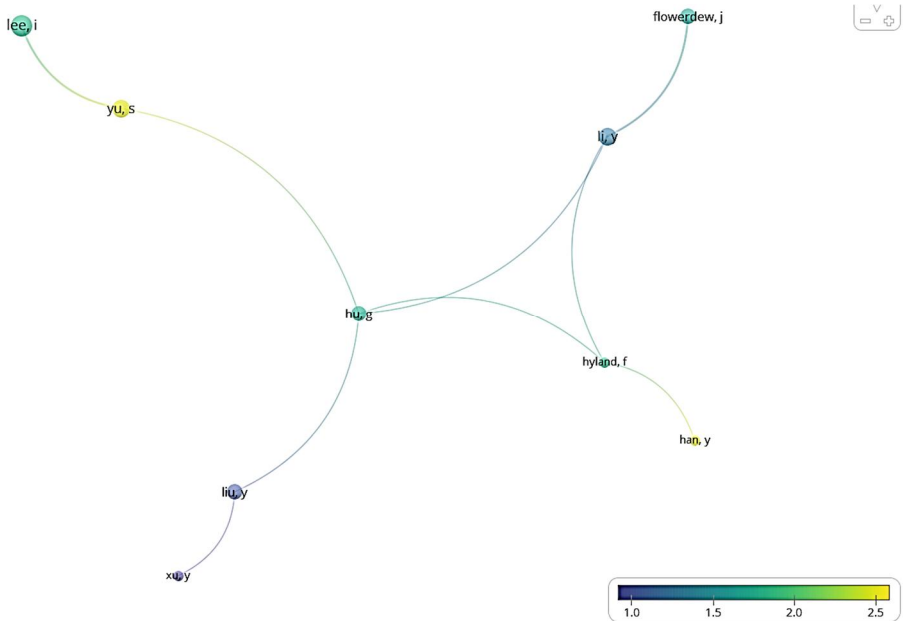


Figure 9 Collaboration map of authors with two or more articles in qualitative research approach

### 3.3.4. Author collaboration by systematic reviews

Our overall findings extracted four clusters that represent groups of reviewers who have collaborated more with one another (Figure 10). Notably, the overall results revealed that systematic reviewers in applied linguistics have mainly set their sights on (methodological) research synthesis, a recent movement initiated by Plonsky (2013, 2014) and his colleagues (e.g., Brown, Derrick, Ghanbar, Teimori, and Egbert). As depicted in Figure 10, Luke Plonsky is at the hub of systematic reviews in applied linguistics (Table 9).

Table 9 A profile of the most eminent collaborators in systematic reviews

Rank	Author	Number of publications	Total link strength	Citation	Average norm citations
1	Plonsky, L.	9	8	541	1.37
2	Lin, H.	4	2	82	0.37
3	Brown, D.	3	2	134	1.02
4	Koizumi, R.	3	3	84	0.54
5	Li, S.	3	2	414	1.66
6	Peterson, M.	3	1	114	0.98
7	Chapelle, C.	2	3	100	1.38
8	Chen, T.	2	2	34	0.60
9	Derrick, D.	2	1	70	1.15
10	In'nami, Y.	2	2	72	0.62

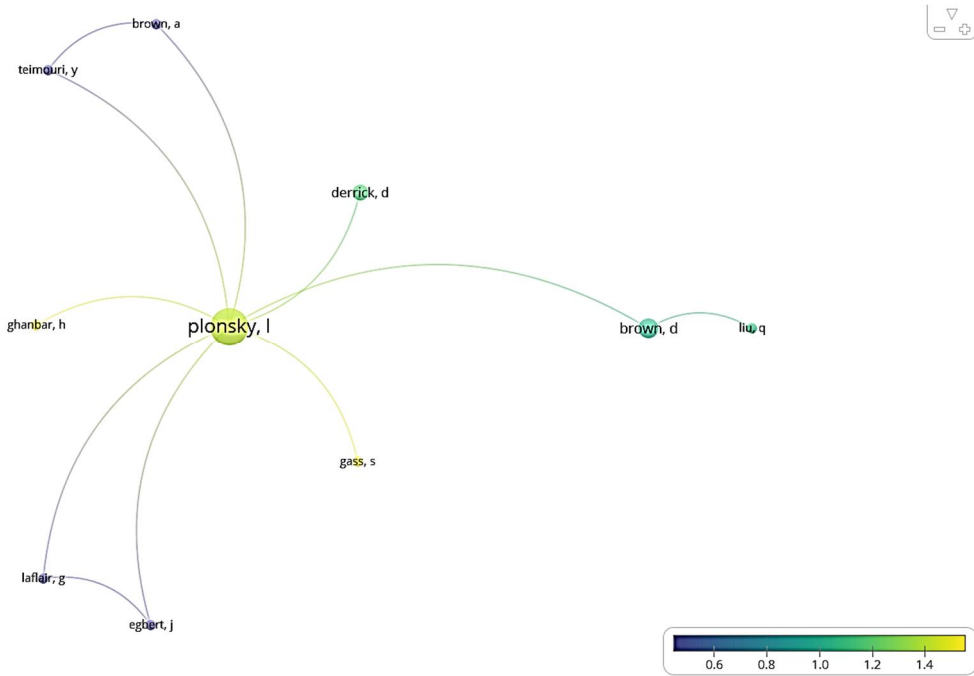


Figure 10 Collaboration map of authors in systematic reviews

#### 4. Discussion

The results related to collaborative patterns at different levels in light of methodological orientations exhibited several patterns of collaboration in the data set. Our findings indicated that the number of co-authored empirical papers exceeded the number of sole-authored ones, and the overall degree of collaboration for AL journals – as computed through a modified formula developed by Subramanyam (1983) – was roughly moderate-to-high (57.7%). As compared with other multidisciplinary sciences (see Table 10), such relatively moderate-to-high collaboration for the discipline-specific field of applied linguistics is warranted given the multidisciplinary nature of journals necessarily push researchers to work as a team in order to examine conceptual issues from different perspectives, methodologies, orientations, and disciplines. Such multidisciplinary thinking styles “make it more difficult for researchers/authors to work alone – hence the increased likelihood of co-authorship” (Onwuegbuzie et al., 2018, p. 452).

Table 10 Cross comparison of the degree of collaboration reported in this study and other studies

Studies	Number of articles (year)	Number of journals/ database	Disciplinary/ methodological focus	DC formula	DC rate (%)
Onwuegbuzie et al. (2018)	1533 (2007-2014)	6	Multidisciplinary/Quan, Qual, and MMR	Subramanyam (1983)	Total = 63 MMR = 69 Quan = 68
Wachsmann et al. (2019)	223 (2007-2018)	1	Multidisciplinary/MMR	Subramanyam (1983)	Qual = 61.25 MMR = 69.5
Nikzad et al. (2011)	380 (2000-2009)	1	Social sciences/total	Ajiferuke et al. (1988)	Total = 84 PSY = 92 ECO = 89 MNG = 86 LIS = 70
<i>Our findings</i>	3,992	18	<i>Applied linguistics/Quan, Qual, MMR, Review</i>	Subramanyam (1983)	Total = 57.7 Qual = 45.5 MMR = 55.7 Review = 60.9 Quan = 66.8

Note. DC = Degree of collaboration; Quan = Quantitative; Qual = Qualitative; MMR = Mixed-methods research; PSY= Psychology; ECO = Economics; MNG = Management; LIS = Library and information science

Furthermore, there is a significant difference between the degree of collaboration and research approaches with this frequency ranking of collaborative patterns: quantitative approach (66.8%) > systematic reviews (60.9%) > MMR (55.7%) > qualitative approach (45.5%). These findings are somewhat similar to the findings of Onwuegbuzie et al. (2018) in that the rate of collaboration in MMR is higher than qualitative studies. However, the result is dissimilar to the findings of Onwuegbuzie et al. (2018) findings as unlike their findings, in our data, quantitative studies had higher collaboration rate than MMR studies. This indicates that applied linguists have predominantly shaped their collaborative pattern through the lens of a quantitative paradigm. Such predominant collaboration is warranted given the recent advancements made in different aspects of quantitative research paradigms in terms of research quality, advanced statistical techniques, statistical literacy, transparency, and the open science movement (Amini Farsani & Babaii, 2020; Plonsky, 2013, 2014, 2017). Furthermore, systematic reviews and mixed-methods studies were reported as the second most collaborative pattern. Such findings might be attributed to the complex nature and cognitive proximity of these two research approaches, wherein knowledge creation and innovations are often supplementary, which in turn needs a high degree of co-authorships (Boschma, 2005).

Concerning applied linguists' collaboration focus at the level of the country, along with the results reported for their scientific and economic collaborative patterns, our overall findings show that the US and the UK are the two main hubs of collaborative activities. We further identified different geographical clusters in the corpus, such as English-Speaking countries, Greater China, Scandinavian countries, Oceanian countries, and Asian countries. Such diversity and comprehensiveness, highlighting the role of distance in collaboration, suggest that applied linguists seek collaborators with geographical proximity and closeness. That is, researchers are attracted to geographically closer co-authors (Pan et al., 2012).

Besides the overall findings, we found several patterns of collaboration in light of research approaches. It seems that the US and the UK are the two main hubs of collaborative activities for quantitative, qualitative, and mixed-methods research. However, the collaborative pattern for systematic reviews is slightly different. The non-Anglophone countries, that is, Taiwan and Japan, were extracted as the second frequently represented hub in the corpus. Such representation might show that systematic reviewers have relatively sought partners with similar interests, irrespective of their geographical proximity. Such transitional movement towards collaboration based on similar areas-of-interest proximity can be further warranted when we examined our collaborative results based on economic and scientific factors. As depicted in Figure 5, the collaborative patterns of SLC-SPC for systematic reviews were represented more frequently than for other research approaches, underscoring other motives for interactions and sharing knowledge. However, to explore such motives and factors, future researchers, adhering to mixed-methods bibliometric studies (Onwuegbuzie et al., 2018), should explore the reasons, motives, and challenges in forming strategic and well-defined collaboration. Although the dominance of Anglophone countries at the hub of collaboration signifies “the unequal participation and underrepresentation of developing countries in global knowledge construction” (Zhao et al., 2017, p. 584), our findings, similar to findings reported by Lei and Liu (2019) in applied linguistics, further indicated the growing participation of developing countries such as Iran and Turkey in shaping collaborative patterns for different research approaches.

With regards to collaboration at the level of authors, our findings highlighted several collaborative patterns for examining L2 issues in light of research approaches. To begin with, our general findings, similar to those reported by Zhang (2020), indicate that quantitative applied linguists have collaborated on different subfields of (I)SLA, which has been inspired by different theoretical underpinnings such as cognitive, individual, and social ones. Furthermore, we found that the most eminent quantitative researchers are those applied linguists who have directly (i.e., Scott Crossley and Danielle McNamara<sup>3</sup>) or indirectly (i.e., Stuart Webb) worked on artificial intelligence (AI) in L2 with a specific focus on natural language processing (NLP) and data mining (e.g., the use of corpus linguistics in SLA). Such findings for a quantitative approach are warranted because data mining, as an interdisciplinary enterprise, is the process of extracting latent patterns in large datasets and consists of a synergy of machine learning, statistical procedures, and pattern recognition (Fayyad et al., 1996; Warschauer et al., 2019).

As for mixed-methods collaborators, our findings indicated that language testing and assessment (LTA) researchers in applied linguistics are mainly attracted

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<sup>3</sup> To find their lines of inquiry, we looked at their papers, academic webpage, and Google Scholar.

to the MMR approach. This result might be attributed to the fact that researchers working in this area often have to address the complexity of “phenomena underlying LTA practices” such as validity claims (Jang et al., 2014). Such complexity necessitates team engagement with a range of expertise. In Bryman’s (2007) terms, “the presence of skill specialisms may lead to compartmentalization or roles and responsibilities that can hinder the integration of findings” (p. 16).

As for qualitative researchers, our findings revealed that the eminent qualitative authors have collaborated on L2 writing issues. This might be related to the dominance of qualitative studies in L2 writing studies, as reported by Pelaez-Morales (2017) and Riazi et al. (2018). As Hyland (2016) asserts,<sup>4</sup> L2 writing studies tend to “favor data gathered in naturalistic rather than controlled conditions” and “there has been a strong preference for collecting data in authentic circumstances not specifically set up for the research, such as via classroom observations or analyses of naturally occurring texts” (p. 121). Furthermore, those affiliated with L2 writing scholarship have conducted their studies within a “constructivist” paradigm (Guba, 1990, p. 27), wherein knowledge creation is shaped through an interaction between researchers and research participants. Such strategic interaction requires collaboration between and among researchers. According to Pelaez-Morales (2017), collaborations have played a positive role in shaping L2 writing scholarship since they often involve researchers with various expertise, and therefore “they contribute to not just geographic diversity, but to diversity in topics and methodologies” (p. 15).

As for systematic reviews, our findings demonstrated that research synthesis is at the hub of collaboration in the corpus. This movement was initiated by Luke Plonsky, who examined different conceptual and methodological issues in the field (meta-analysis, methodological synthesis, second-order research synthesis). As Byrnes (2013) rightly asserts, the research synthesis methodology is a “lively testimony to the fact that methodologies no longer have ancillary status in our work” (p. 825). Accordingly, our findings suggest that we can update the list of professionally leading applied linguists (de Bot, 2015) by embracing Luke Plonsky, an American methodologist, who has mainly examined the methodological research quality of the primary and secondary studies.

## 5. Conclusion

Employing research synthetic techniques and bibliometric analysis, we examined the collaborative behaviors of applied linguists at different levels (i.e., author,

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<sup>4</sup> Ken Hyland is one of the most highly eminent qualitative authors in the corpus with his expertise in L2 writing.

country, and the rate of collaboration) in light of methodological orientations. Our findings, lending empirical support to McKinley's (2020) assertions on theorizing AL research, can provide solid evidence for shaping and even expanding AL research in light of bibliometric indicators.

The concomitant reporting of collaborative patterns and research approaches provides applied linguistics with a comprehensively transparent picture of each research methodology and the required collaboration. Such synergy is timely and empirically warranted because, as a field, "we have moved beyond types of research that, while still of value, offers limited contribution, and towards highly impactful research" (McKinley, 2020, p. 2). Likewise, Plonsky and Oswald (2015) argue that progress in AL research is highly dependent on "sound research methods, principled data analysis, and transparent reporting practices" (p. 325). Considering our findings and given the centrality of collaboration in enhancing research quality, we expand this assertion to the following statement: Progress in applied linguistics is highly dependent upon sound research methods, principled data analysis, transparent reporting practices, and *strategic collaborations*.

Besides methodological implications, the findings of the study also have some implications for researchers, co-authors, journal editors, and reviewers. More specifically, editors can ask (co)authors to dedicate a section to delineate the transparent role (i.e., conceptual and methodological roles) each author played in shaping their manuscript. For example, Hill et al. (2020) in an article published in the *Journal of English for Specific Purposes* delineate the role of collaborators (see also Riaz et al. (2020) for a collaboration report):

Christopher Hill: conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing, visualization, project administration, funding acquisition. Susan Khoo: conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing – review & editing, visualization, project administration, funding acquisition. Yi-Chin Hsieh: validation, formal analysis, investigation, resources, data curation, writing – review & editing, visualization.

Nevertheless, the nature of such collaboration and the reasons, motives, and challenges await future researchers. One line of research is to examine the collaborative nature of each research approach, notably mixed-methods research and research synthesis, which needs more cognitive processing than the monomethod research approach. In particular, employing the mixed-methods bibliometric approach (Onwuegbuzie et al., 2018), prospective researchers should examine the collaborative pattern of authors, countries, institutions, and their authors' perceptions and attitudes towards collaboration. Likewise, examining keywords and topical issues in light of research orientations is another appealing

line of research awaiting future researchers. In line with the findings reported by Lei and Liu (2019), we also found the rise of collaborative participation of developing countries such as Iran and Turkey in the field. Accordingly, to compare patterns of collaboration in periphery countries with core counterparts, prospective researchers should examine context-specific patterns of collaboration at different levels.



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