Hussein Meihami
Rajab Esfandiari *Editors*

A Scientometrics Research Perspective in Applied Linguistics

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A. Mehdi Riazi obtained his PhD in Applied Linguistics from the University of Toronto. He has supervised 50 master's and 22 doctoral theses to completion. He has been the chief investigator for three research projects on test validation funded by IELTS, Pearson, and Educational Testing Service (the writing section of the TOEFL-iBT). He is the author of the *Routledge Encyclopedia of Research Methods* (Routledge, 2016), *Mixed Methods Research* (Equinox, 2017), and more. His academic works have been cited 4,397 times by other researchers. He has an h-index of 33 and an ih-index of 63 according to Google Scholar.

Abbreviations

AAAL	American Association of Applied Linguistics
ACA	Author Co-Citation Analysis
AHCI	Art and Humanities Citation Index
AL	Applied Linguistics
APIs	Application Programming Interfaces
BALL	British Association of Applied Linguistics
BKCI-S	Book Citation Index – Science
BKCI-SSH	Book Citation Index – Social Sciences and Humanities
CALL	Computer Assisted Language Learning
CLIL	Content and Language Integrated Learning
CPCI-S	Conference Proceedings Index – Science
CPCI-SSH	Conference Proceedings Citation Index – Social Science and Humanities
CSV	Comma-Separated Values
DA	Discriminant Analysis
DCA	Document Co-Citation Analysis
DDL	Data-Driven Learning
EAL	English as an Additional Language
EAP	English for Academic Purposes
ECR	Early Career Researchers
EFL	English as a Foreign Language
EMI	English Medium Instruction
ERIC	Education Resources Information Center
ERPP	English for Research Publication Purposes
ESCI	Emerging Sources Citation Indexes
ESP	English for Specific Purposes
FDH	Fundamental Difference Hypothesis
HSS	Humanities and Social Sciences
KfAbs	Keywords from Abstracts
KfAus	Keywords from Authors
KWIC	Key-Word-In-Context

LDA	Latent Dirichlet Allocation
MALL	Mobile Assisted Language Learning
MLJ	Modern Language Journal
MMR	Mixed-Methods Research
PLSA	Probabilistic Latent Semantic Analysis
PNG	Portable Network Graphics
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RA	Research Article
RALL	Robot Assisted Language Learning
SCI	Science Citation Index Expanded
SEM	Structural Equation Modelling
SLA	Second Language Acquisition
SSCI	Social Sciences Citation Index
SSH	Social Sciences and Humanities
TAALES	Automatic Analysis of Lexical Sophistication
TBLT	Task Based Language Teaching
TBP	Thesis by Publication
TEFL	Teaching English as a Foreign Language
TESL	Teaching English as a Second Language
TESOL	Teaching English to Students of Other Languages
TGCS	Total Global Citation Counts of Studies
TLCS	Total Local Citation Counts
TXT	Text File
WoK	Web of Knowledge
WoS	Web of Science

Introduction to a Scientometrics Research Perspective in Applied Linguistics

Hussein Meihami and Rajab Esfandiari

1 Scientometrics: Definitions, Distinctions, and Objectives

The ever-increasing complexity of language constructs, the close affinity of applied linguistics with neighboring disciplines such as psycholinguistics, the interdisciplinary nature of the field, the consistent inroad of concepts from other disciplines into the field, the emergence of multilingual contexts, the advent of big data, and technological breakthroughs and globalization and its impacts on the field motivate researchers to redefine the field from time to time, theoretically advancing it. Theoretical advancement of applied linguistics requires the theorization and problematization of the research methods, which, as McKinley (2020) rightly asserted, the field is grappling with to unpack its complexities.

Scientometrics is one way to theorize applied linguistics research. Vassily Vassilievich Nalimov, the Russian mathematician, is generally credited with first coining the term scientometrics and defining it as the application of quantitative methods to all scientific activities in all disciplines, with no distinction between natural sciences, social sciences, and humanities such as the humanities (Gingras 2016; Sooryamoorthy 2021), although, as Sooryamoorthy pointed out, it was initially primarily applied to science and scientific knowledge. Therefore, scientometrics, as De Bellis (2009) neatly summarised, "encompasses all quantitative aspects and models related to the production and dissemination of scientific and technological knowledge", the ultimate goal of which is to address "the quantitative and comparative evaluation of scientists', groups', institutions', and countries' contribution to the advancement of knowledge" (p. 3). Scientometrics uses various sources of scientific research data for analysis, such as the count of publications in

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small and large databases like Scopus (Esfandiari and Saleh 2023; Meihami and Esfandiari 2021; Roemer and Borchardt 2015; Rashidi and Meihami 2018; Sahragard and Meihami 2016) and employs multifarious units of analysis, including, but not limited to, documents such as journal articles as well as groups of scientists, institutes, and countries (De Bellis 2009) at three levels of aggregation: micro (publication outputs of research groups), meso (publication outputs of institutes), and macro (publication outputs of countries) (Glänzel 2003).

Scientometrics draws on a wide variety of instruments and analysis techniques. Because it is fundamentally quantitative, the instruments applied in scientometrics include mathematical processing, comparison, classification and visualization, and advanced statistical procedures such as multi-level analysis to process the data (Ivancheva 2008). It also builds on such techniques as co-citation analysis, co-word analysis, network visualization, resonance analysis, and bibliometric coupling (see Sooryamoorthy 2021, for an outline of these techniques) to establish the relationship between citations in research publications, to map the structure and dynamics of disciplines (Chen 2017), to assess and evaluate research activities and journal impact (Siluo et al. 2020), and identify patterns of collaboration and co-authorship in research activities (Wang et al. 2017).

Since its inception in 1969, scientometrics has matured into a field of research and evolved into an effective instrument for research assessment, evaluation, and impact. These days, researchers are using scientometrics "to analyze, quantify, and measure communication phenomena to build accurate formal representations of their behavior for explanatory, evaluative, and administrative purposes" (De Bellis 2009, p. 3). From this point of view, scientometrics overlaps, and is most often synonymous, with bibliometrics, a term that Pritchard (1969) coined and defined as "the application of mathematics and statistical methods to the analysis of academic publications" (p. 348). However, as Gingras (2016) argued, bibliometrics is limited to the counting and analysis of published documents and their properties and, as such, is a subset of scientometrics, which uses bibliometric data and techniques to study the science of communication (De Bellis 2009). All told, we use both terms interchangeably unless otherwise indicated.

Scientometrics appears to have found its way into applied linguistics, as can be seen from the most recent research publications in applied linguistics-related research journals such as System, Applied Linguistics, and English for Specific Purposes. Though very few, some of these scientometric research papers have used co-citation analysis to diachronically analyse research articles in specific research journals such as System, in such sub-fields as English for specific purposes (ESP), computer assisted language learning (CALL), second language writing, and English language teaching and learning in applied linguistics, to identify the major research themes and topics, landmark publications, and historical research trends to map the structure and dynamics of the sub-fields (Arik and Arik 2017, 2021; Hyland and Jiang 2021; Liu and Hu 2021). Some others have adopted a broader perspective, exploring research productivity and research trends in applied linguistics research journals to identify the most frequently explored research topics and most highly cited publications (including journal articles, books, and book chapters); the most

highly cited authors; and the most productive countries/regions (Amini Farsani et al. 2021; Lei and Liu 2019). Still, other, more recent studies have analyzed topics such as task-based language teaching (Qin and Lei 2022), multilingualism (Lin and Lei 2020), interaction (Hyland and Jiang 2022), and authenticity (Hasrol et al. 2022), among others.

Such research studies have explored some uses and applications of scientometrics in applied linguistics to broaden our understanding of the field. As such, given the significance attached to research productivity, researcher visibility, research assessment and evaluation of researchers' research activities for promotion, research impact, fierce competitiveness of the research world, securing funding, and the ranking of the institutions, a book which introduces major themes, common techniques, and applications of scientometrics to applied linguistics readership is strongly felt.

Adopting a scientometrics research perspective in applied linguistics, therefore, helps us to examine disciplinary research practices quantitatively, statistically measure research development and growth, and textually (and contextually) analyze research documents, including research papers. Such a quantitatively-oriented, statistically-based, and (con)textually documented analysis of applied linguistics research phenomena contributes to the enrichment of research methodology, advancement of research theorization, and professionalization in applied linguistics as an independent field of inquiry, on the one hand, and leads to clearly delineating the boundaries of the field and characterizing its positioning in relation to neighboring disciplines from which it borrows, on the other hand.

Built on the above premises, our edited book covers a diachronic and synchronic empirical analysis of research practices, concepts, and phenomena in applied linguistics. We intend to use Scientometrics research methods, techniques, and concepts such as document co-citation analysis to look into research trends and publications, research orientations and approaches, citation behavior and practices, publication growth, and research productivity, to name just a few. The incorporation of such topics theoretically backed by Scientometrics may open new horizons for further research.

Such a theoretical research perspective and topic treatment in our edited textbook help emerging applied linguistics researchers, researcher-practitioners, and MA and PhD students to better understand where the field was, tracing the major research developments in the field over the past few decades, what research practices are being done now; and what future research directions the field is likely to follow. The book provides these stakeholders with a wealth of research ideas to choose from for further analysis, to strengthen their knowledge of the field, and to help them digest research practices, research publications, research trends, research policies, and research methods. The book will be useful for well-established applied linguistics researchers because it offers insights into reconceptualizing the field, prompting them to view and examine the research topics from a different theoretical research perspective.

Our edited book, therefore, is primarily intended for graduate student writers and novice applied linguistics researchers. For graduate student writers, the book

introduces bibliometric techniques in applied linguistics, which can be exploited to map the structure and dynamics of the field, to trace applied linguistics research growth and development diachronically, and to know the most highly cited research publications, research trends and topics, and authors. From a pedagogical point of view, this will help them to save time (especially if they are first-timers), investing in only those research activities that have appealed to researchers in the field to start their research works. Furthermore, in addition to those conventional quantitative tests in applied linguistics, the book familiarises them with some common analysis and visualization techniques, such as co-network analysis, for the analysis of bibliometric data. Such alternative analyses coupled with more conventional statistics tests such as chi-square tests (widely used in scientometric studies to show statistical relationships between citations and counts of publications) may contribute to meaning construction, validation of analyses of data, and theory building.

We have framed the book to center on the three most frequently cited applications of scientometrics to applied linguistics: Research methodology, research evaluation, and mapping of the discipline (Andrés 2009). The chapters offer readers a wealth of ideas about what scientometrics is, how it differs from neighboring disciplines such as informetrics, and, most importantly, how scientometrics can be used in applied linguistics to theorize the field, extending its boundaries and reconceptualizing it. In the following section of the chapter, we outline the structure of the present volume.

2 Structure of the Present Volume

The present volume includes nine chapters, the summaries of which we present here. In Chapter "Introduction to A Scientometrics Research Perspective in Applied Linguistics", Hussein Meihami and Rajab Esfandiari, the volume editors, introduce scientometrics to readers, differentiate scientometrics from other, similar terms (e.g., bibliometrics), describe the various scientometric research methods for data collection and analysis, explain how it has been used in applied linguistics, justify the rationale behind editing the volume, and outline the objectives of the volume.

In Chapter "Exploring the Evolution of Applied Linguistics: A Bibliometric Survey of Major Research Paradigms", Dahui Dong of the Chang Jung Christian University, Taiwan, and Ming Yuan Dong of Tamkang University, Taiwan, combined bibliometric tools (document co-citation analysis) and mine mapping (co-word analysis), respectively, to identify major applied linguistics (AL) research areas and detect the fundamental paradigms informing the areas in applied linguistics journals over the past 70 years. Building on 23,790 records, Dong and Dong identified 12 major areas, with the earliest years characterized by foreign language requirements and language learning in universities and the most recent years by more diverse areas, including multilingualism, corpus-based studies, and culture and L2 identity. The results of the topic modeling through co-word clustering revealed four major paradigms: positivism, post-positivism, constructivism, and critical theory, with positivism the most dominant one and the coexistence of the

other three paradigms competing for recognition. In Dong and Dong's words, "the coexistence of multiple paradigms emphasizes the importance of open-mindedness and flexibility in approaching research questions and interpreting findings." Drawing on these findings, the authors discuss the implications, limitations, and suggestions for further study.

In Chapter "Research Trends in Applied Linguistics (2017–2021): A Scientometric Review of 42 Journals", Yanhua Liu of the Hong Kong University of Science and Technology, China, and Guangwei Hu of the Hong Kong Polytechnic University, China, have drawn on Liu and Hu's (2021) study to update research trends in applied linguistics. For this purpose, the authors analyzed 7602 applied linguistics articles (with 198,861 unique references) from 42 applied linguistics journals published between 2017 and 2021 to identify the most frequently discussed topics and the most highly cited publications and authors. Results from topic term analysis and document co-citation analysis showed a surge in multilingualism and translanguaging; a growing interest in psychological factors, cognitive and instructional approaches, and teacher-related variables; continued attention to vocabulary learning, pronunciation instruction, and speech fluency; and the surging adoption of new methodological toolkits such as R statistics, mixed-effects models, and thematic analysis, among others. In addition to the research topics and publications, Canagarajah, Garcia, Nation, R Core Team, and Bates were identified to be the most highly cited authors. Using the research trends, Liu and Hu were able to establish relationships between discussed topics, research publications, and cited authors.

In Chapter "Topical Trends and Research Frontiers of Applied Linguistics Research Articles with Different Methodological Orientations: A Bibliometric-Synthetic Review", Mohammad Amini Farsani of Iran University of Science and Technology, Iran, and Hamid R. Jamali of Charles Sturt University, Australia, invest in bibliometric-synthetic methodology to review 3824 empirical articles in 18 applied linguistics research journals from 2009 to 2018 to track research trends (topics and frontiers) in primary (quantitative, qualitative, and mixed-methods) and secondary research. Co-word analyses revealed the following results. Language testing and assessment, discourse analysis and interaction, SLA-related issues, and L2 feedback as research strands were represented in quantitative, qualitative, mixed-methods, and secondary studies, respectively. Although SLA-related issues received the highest focus in quantitative and secondary studies, qualitative and mixed-methods research orientations mainly addressed academic writing. In closing the chapter, the authors discuss several implications the findings of the study may offer in undertaking to conduct primary studies as well as reviewing and synthesizing research.

In Chapter "Research Topics in Applied Linguistics as Keywords from Authors and Keywords from Abstracts: A Bibliometric Study", William S. Pearson of the University of Exeter, England, reports on the findings from the analyses of author-assigned keywords of 23,481 research articles in 42 applied linguistics research journals across three time spans from 2001 to 2021. In terms of the prevalence of keywords, author-provided keywords tended to gradually increase from 40.25%

during the first time interval (2001–2009) to 66.81% during the second time interval (2010–2015), to 73.33% during the third time interval (2016–2021), suggesting the (possible) requirement of the provision of keywords. The applied linguistics authors chose to include between four and six keywords, constituting 79.09% of the papers, with five keywords being the most frequently used (35.36%) with a slight increase of 12.56%, followed by six words (22.79%), and four words (20.94%). This finding, as Pearson commented, reflects the standardization across journals and publishers. As far as keyword lengths (measured by the number of words each keyword contains) are concerned, although keywords from one to five words in length were the most frequently assigned, single-word keywords tended to slightly decrease, with two-and three-word keywords marginally increasing, and four-and five-word keywords being relatively stable over time. The tendency for a larger number of words, as Pearson speculated, suggests an inclination towards greater keyword lengths and, by implication, more precision. Structurally, single noun, adjective + noun, and noun + noun keywords were the most frequently used structure patterns, respectively, albeit with fluctuating frequency counts over time. In terms of constituent word forms, nouns and adjectives were the two most frequently used word classes in keywords. Pearson found a mismatch between author-supplied keywords and abstracts because 48.62% of keywords were not present in the accompanying RA abstract. These findings motivate Pearson to conclude that author-provided keywords "encompass both an important methodological tool to support other measures and a source of insights into the state of a literature body", with implications for future bibliometric analyses.

In Chapter "A Bibliometric Analysis of Mixed Methods Research (MMR) in Applied Linguistics (AL)", Hessameddin Ghanbar of Islamic Azad University, Iran and A. Mehdi Riazi of Hamad Bin Khalifa University, Qatar, report on a timely bibliometric analysis of 256 mixed-methods research (MMR) studies in 18 prominent applied linguistics journals from 1984 to 2022. Investing in citation analysis of impact and author and document co-citation analyses, Ghanbar and Riazi map out the publication trends of MMR studies as well as the frequency of occurrence in the journals to identify the most highly cited institutes, countries, MMR papers and authors. The results of their bibliometric analyses generally show an upward increase in the number of published MMR studies in the field since 2008, but no regular pattern was detected for the number of times they were cited. The highest number of papers (n = 45, 18%) was published in *System*; in contrast, *Second Language Research* received the lowest number of papers (n = 2, 1%). In terms of citation impact, however, *Computer-assisted Language Learning* received the most frequently cited MMR studies. University of Lancaster, Macquarie University, and Iowa State University were the three top universities (out of 300 universities) to publish MMR studies; the United States of America was the first country (out of 43 countries) to publish the highest number of MMR studies (n = 87, 29.7), followed by the United Kingdom (n = 39,13.3), China (n = 29, 9.9), and Iran (n = 19, 6.5). Derwing et al. (2008), a longitudinal study of ESL learners' fluency and comprehensibility development in Applied Linguistics, was the most frequently cited MMR paper (118 times). In terms of document co-citation analysis, the cognitive perspective was the most dominant theme in the 37 most highly cited

references. From an author co-citation perspective, Zoltán Dörnyei, John W. Creswell, Peter MacIntyre, Rod Ellis, and Ken Hyland were the five top-cited authors. The findings of the study point to an empirical discovery that just because MMR studies are the most frequent does not necessarily imply they are the most frequently cited, revealing a mismatch between the frequency of publication trends and citation impact. Ghanbar and Riazi use the findings to discuss implications for submission purposes.

In Chapter "An Analysis of Writing for Publication Research on Novice Anglophone (L1) Academics: A Scientometric Perspective", Pejman Habibie of Western University, Canada, and Ismaeil Fazel University of British Columbia in Vancouver, Canada, have focused on a comparatively less research subarea in applied linguistics: Writing for publication research. Following manual coding and bibliometric techniques, Habibie and Fazel have analyzed a relatively small corpus of 50 research articles and book chapters of Anglophone novice scholars (graduate students and early career academics) across various disciplinary and geographical settings from 2001 to 2023. The authors organize the findings into five major categories: (1) publication trends and authorship patterns, (2) contexts and participants, (3) research foci and theoretical frames, (4) research design and data sources, and (5) practical implications and recommendations. They find that writing for publication research has witnessed an increasing number of publications, the majority of which include research articles from single and multiple-authored early career researchers in countries such as Australia, New Zealand, and many European countries. Almost three-fourths of the studies focused on experiences with scholarly publication, and qualitatively oriented studies (n = 41, 80%) outnumbered quantitative and mixed-methods studies, which tended to be marginalized. The majority of studies asked for explicit pedagogical training in writing for scholarly publication, the need for scaffolded support provided by supervisors, and further transparency and clarity in terms of policies for candidates and supervisors. The results of the co-word analysis showed that doctoral education, research translation, and early career researchers were the three top research topics receiving scholarly attention.

In Chapter "Bibliometrix: Science Mapping Analysis with R Biblioshiny Based on Web of Science in Applied Linguistics", Babak Daneshvar Ghorbani of Iran University of Science and Technology, Iran, uses Bibliometrix, an R-based, open-source computer program for bibliometric analyses, to explain, step by step, the procedures for the analysis of bibliographical data. For this purpose, Ghorbani draws on 881 articles in English language teaching and technology from 1538 authors between 2013 and 2022. The author demonstrates how it is possible to use bibliometric techniques, including network analysis, co-citation analysis, co-word analysis, and biographic coupling, among others, to identify the most highly cited authors, themes, publications, and countries; to establish the relationships between publications; and to sketch out international collaboration. As such, this book chapter provides hands-on information for newcomers to Scientometrics who intend to do bibliometric analyses on publications. Daneshvar Ghorbani finds that although the largest number of articles (n = 122) was published in 2022, no regular pattern was detected concerning a symmetric distribution of articles across the years.

Computer-assisted Language Learning, International Journal of Computer-assisted Language Learning and Teaching, and *System* published the highest number of articles (n = 362) and received the highest number of citations (3780). Wy Hwang, LJ Jiang, and S. Ebadi were the most highly cited authors, and the majority of the authors were from Islamic Azad University in Iran (n = 36), National Taiwan Normal University in China (n = 26), Education University in Hong Kong (n = 20), and Iowa State University in the United States of America (n = 19). China, the United States of America, and Iran were the three top countries in which the authors collaborated with other authors to produce the highest number of articles. The author builds on Lotka's law and Bradford's law to interpret the findings. Daneshvar Ghorbani closes the chapter, reminding us of the numerous advantages the special-purpose computer package Bibliomtrix can offer.

Last but not least, in the concluding Chapter "Concluding Remarks: Recommendations and Future Directions", Rajab Esfandiari and Hussein Meihami use the information in the chapters in this volume to provide an overview of scientometrics in applied linguistics. In doing so, we discuss the theoretical, pedagogical, and research implications that applying scientometrics may carry for applied linguistics and offer suggestions for future research.

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Exploring the Evolution of Applied Linguistics: A Bibliometric Survey of Major Research Paradigms

Dahui Dong and Ming Yuan Dong

1 Introduction

1.1 Defining Paradigm

Thomas Kuhn proposed the term "paradigm" in The Structure of Scientific Revolutions to refer to shared beliefs of research groups, including assumptions, models, values, and principles (Kuhn 1962). From a philosophical standpoint, Kuhn's "paradigm" has been viewed as a worldview due to its essential characteristic of "incommensurability", which means that the difference between successive paradigms is irreconcilable (Masterman 1970). This view involves a process of emergence and changing paradigms and is considered a "revolution" with different mental states and not formed by transformation (Kuhn 1962). According to Kuhn (1962, 10), the development of science involves the replacement of old paradigms with new ones, such as the shift from Aristotelian to Galilean physics or the shift from the phlogiston theory to the oxygen theory of combustion, which occurs through phases of emergence, development, and decline. These paradigm shifts represent a constant revolution providing a problem-solving framework (Kuhn 1962).

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1.2 Research of Paradigms in Humanities and Social Sciences

Kuhn employs the term "paradigm" to describe the humanities and social sciences (HSS) infrequently, and he feels that "branches of the social sciences, if any, have already achieved such paradigms remains entirely open" (Kuhn 1962, 12). Although it is widely acknowledged that HSS disciplines lack a cohesive paradigm, this does not imply that there is no paradigm. In reality, new and old paradigms (or schools) can coexist and compete (Giddens 1986; Laudan 1996). Kuhn's idea of "paradigm" has been extensively utilized in HSS research to address the three essential philosophical concerns that must be answered in any field of study: ontology, epistemology, and methodology (Bettis and Gregson 2001; Creswell et al. 2018; Guba and Lincoln 1994). While ontology attempts to answer the question, "What does the world consist of?" and methodology focuses on how to realize reality, epistemology investigates the relationship between the researcher and the world. Additionally, research paradigms also include axiology and rhetoric. Axiology considers values and ethics and how they impact the research process (Maxwell 2013), while rhetoric refers to the persuasive language used in research, such as the framing of research questions, the interpretation of data, and the presentation of findings (Yanow and Schwartz-Shea 2015). By considering all these components, researchers can comprehensively understand their research paradigm and its implications for their work.

Humanities and social sciences research categorizes paradigms positivism, post-positivism, interpretivism, critical theory, constructivism, and participatory (Guba and Lincoln 1994, 2005). Each paradigm has its own understanding of the universe and its own set of underlying assumptions. Positivism assumes that the world is a measurable and observable objective reality and often uses quantitative methods (Popper 1959). Interpretivism posits that social interaction produces meanings in the universe (Gadamer 2013) and uses qualitative methodologies to study these meanings. Critical theory and post-positivism are two postmodernist paradigms used in HSS research that share some similarities. While critical theory assumes that the world consists of power relations that can be used to oppress and marginalize certain people (Marcuse 1964), post-positivism assumes that the universe is composed of various realities that can be understood from multiple perspectives (Guba and Lincoln 2005). Both paradigms employ mixed-methods to investigate the world, drawing from a combination of quantitative and qualitative research techniques.

The current usage of "post" in the HSS indicates a trend of deconstructing existing paradigms and establishing new ones (Wexler 1995). This trend is also evident in the convergence of several specific sciences, with the mutual penetration of categories, ideas, and methodologies between natural and social sciences resulting in the formation of comprehensive disciplines that employ multiple disciplines to investigate difficult topics (Chadha and Thomas 2022).

Concerns also stem from the failure to acknowledge that paradigms are not research approaches (Crotty 1998). This is evident in the theoretical perspective of research paradigms, which directly informs the research's overall design, showing

itself in data collecting and analysis techniques. Wallerstein (1996), Crotty (1998), and Case (1998) have all concluded that researchers have improperly understood, evaluated, selected, and utilized paradigms. Many cannot identify the philosophical assumptions behind their study (Bryman 2006; Gorard et al. 2004). Symbolic interactionism, ethnography, and constructionism, for instance, are listed as "methodologies", "approaches", "perspectives", etc., by Crotty (1998), who remarked that many researchers conflate research methods with paradigms. Similarly, Case (1998) discovered a broad variety of opinions regarding the goals and methods of education and a lack of consensus regarding the nature of knowledge itself.

1.3 Exploring the Paradigms of AL

Applied Linguistics is a field that utilizes linguistic theories and methods to examine real-world issues in language use and education, focusing on language teaching, language planning, and language policy (Ellis and Shintani 2014). It is also concerned with developing language education policies and practices and examining how social, political, and economic factors influence the use and teaching of languages (Kaplan and Baldauf 1997). Recent years have witnessed a methodological turn and an increased awareness of research paradigms in AL, leading to an unprecedented "golden age" of research growth (McKinley 2019; Plonsky 2013, 2017). This growth is attributed to numerous studies accounting for AL research paradigms from various philosophical perspectives (Ahmed et al. 2021; Farsani et al. 2021; Hashemi 2019; Lian and Sussex 2018; McKinley and Rose 2019) and the recognition of the importance of research methods in AL (Brown 2014; Plonsky 2013, 2015, 2017). McKinley (2019), for instance, describes research paradigms as the philosophy underpinning the knowledge or reality a researcher employs to comprehend a phenomenon, and prevalent research paradigms in AL include positivism, post-positivism, interpretivism, critical inquiry, pragmatism, and participative. While AL paradigms were categorized as positivism and post-positivism in the early works of Jacobs and Farrell (2001) and Torabi (2011), Lian and Sussex (2018) explored the pragmatist paradigm, Ahmed et al. (2021) discussed the participatory paradigm, and Farsani et al. (2021) explored the postmodern paradigm. As the field of AL continues to evolve, it is important to recognize and explore the limitations of traditional research paradigms such as positivism and post-positivism and to embrace a more diverse range of philosophical perspectives and approaches to research that can better capture the complexity and diversity of language use and education in the real world.

In addition, some AL scholars have examined research paradigms from the standpoint of thinking schools (Kumaravadivelu 2006; Vygotsky 1978), theories (Holliday and Macdonald 2020; Zuengler and Miller 2006), and ontology (Corson, and David 1997). Hashemi (2019) highlighted several philosophical perspectives appropriate to AL research, including critical realism, dialectic stance, dialectical pluralism, critical dialectical pluralism, transformative paradigm, and performative

paradigm. These philosophical perspectives align with the argument made by Creswell and David Creswell (2018), who argued for the need to adopt a mixed-methods approach that combines quantitative and qualitative research methods to gain a more comprehensive understanding of the complex issues in AL research.

The evolution of HSS concepts has unavoidably influenced the research of AL. Similar to the debate between quantitative and qualitative research in HSS, which focuses on the evolution of three research methods: quantitative research, qualitative research, and mixed-methods research (MMR), the debate surrounding paradigms in AL research focuses primarily on the quantitative and qualitative paradigms (Bryman 1984, 2006; Hashemi 2019; Lapid 1989; Larsen-Freeman 2007). In the 1980s, AL research transitioned from the conventional speculative research paradigm to the empirical research paradigm due to the infiltration of the natural science research model into the field (Gao et al. 2001). When positivism collapsed in HSS research in the mid-1990s, AL research turned to qualitative research, focusing mostly on qualitative data, and was dominated by interpretive methodologies and critical theories (Risager 2011; Torabi 2011). With the strong support of post-positivism in the HSS in the early twenty-first century, post-positivism also emerged in AL. Some scholars believe that post-positivism has become an alternative paradigm to positivism, advocating the use of MMR and that post-positivism has become a new paradigm that provides AL with rich research paths (Jacobs and Farrell 2001; Weideman 2013a). In recent years, AL scholars have been looking for ways to integrate paradigms for conducting MMR studies (Farsani and Babaii 2020; Farsani et al. 2021; Riazi 2016a, 2016b; Riazi et al. 2020).

Pennycook (2018) suggests that there has been a paradigm shift in AL due to its growing relationship with other disciplines, such as natural sciences. However, some researchers argue there is no shift to post-positivism in AL. For instance, Yüce et al. (2014) examined the research paradigms and designs of doctoral theses conducted in AL in Turkey since 2000 and analyzed how the paradigm shift affected AL. The research revealed that experimental and descriptive research designs remained the most prevalent in doctoral dissertations and that post-positivism did not emerge as the dominant paradigm. In Teaching English as a Foreign Language (TEFL) research, studies by Farsani and Babaii (2020) suggest that most research continues to use traditional paradigms and designs, with a focus on quantitative methods, but there is a growing trend toward the use of MMR and recognition of the value of qualitative methods. Overall, it appears that the debate around research paradigms and designs in AL research continues, with some arguing for a paradigm shift towards post-positivism and others maintaining that traditional research paradigms and designs still have value in these fields.

In addition, it has been found that AL researchers and researchers in other HSS disciplines lack a consistent philosophical dimension to define research paradigms (Benton and Craib 2011; Berkovich 2018; Christopher 2017). In research practice, the majority of researchers, such as those discussed by Hashemi (2019), concentrate on methodological orientations, which entails integrating qualitative and quantitative research approaches, but few openly state the philosophical basis of their research (Gorard et al. 2004; Hashemi 2019). For instance, Gorard et al. (2004)

discovered that the majority of researchers reported employing some quantitative approaches, but the "quantitative" abilities were weak, and the quality of educational research was generally poor. This suggests a need for AL researchers to pay closer attention to both the philosophical underpinnings and the purpose of their research when considering the use of MMR approaches, as highlighted by recent studies in the field, such as those by Farsani and Babaii (2020) and Farsani et al. (2021).

Early on, Corson (1997) observed that it appeared that AL was emerging and operating without a cohesive or consistent governing paradigm. Pederson (2006) also noted that researchers in the field of second and foreign language teaching, a subfield of AL, lacked the appropriate paradigm criticism awareness and were unable to comprehend the context of discipline development and the internal structure and development rules of the discipline. In numerous AL journal articles, just "methods" and methodology are discussed; ontology and epistemology are ignored (Carter and Little 2007). Ortega (2012) contends that SLA, another branch of AL, has witnessed a variety of epistemological perspectives, but many scholars fail to critically assess paradigmatic assumptions, views, methodologies, and categories, impeding the advancement of AL. Given the interdisciplinary nature of AL, it may not be easy to develop a consensus on fundamental terms such as knowledge or practice, as noted by Wagner (2019). This highlights the need for continued discourse and reflection on the philosophical foundations of AL research.

Consequently, it has been argued that AL research has failed to engage in substantive ontological and epistemological arguments over research paradigms (Hashemi 2019). This has led to AL scholars placing themselves in the area according to their research strands, such as applied linguists, sociolinguists, (applied) cognitive linguists, psycholinguists, neurolinguists, etc. These terms are intrinsically imprecise because of their vast character, which transcends mere academic fields (McKinley 2019).

2 Bibliometric Studies in AL

Over the past two decades, there have been substantial changes in AL research. According to Lei and Liu (2019a), who conducted the first bibliometric analysis of 2005–2016 research trends in AL, certain topics, such as the effects of socioeconomic class and multilingualism, have gained more interest, while some linguistic topics have decreased. The study, which aimed to identify popular topics and changes in research trends in AL over time, also found an increase in new theories and a shift in publication rates in different countries. These findings provide deeper insights into language learning and communication and suggest a need for further investigation. In addition, Lin and Lei (2020) also examined the research on bilingualism or multilingualism conducted over the past two decades and discovered that there had been a change in AL toward the study of bilingualism and multilingualism from multilingual perspectives.

Using bibliometrics methods, AL researchers have attempted to examine AL paradigms in terms of research methodology. Meihami (2020) and Amini Farsani

et al. (2021) did two similar studies on the approach for AL research. Meihami (2020) examined 3491 publications published by seven main AL journals between 1980 and 2019, whereas Amini Farsani et al. (2021) conducted a study aimed at exploring the role of bibliometrics, notably citation and collaboration, analyzing 3992 articles published by 18 leading AL journals between 2009 and 2018. Both surveys revealed that quantitative research methods were the most prevalent. In addition, Meihami (2020) stated that from 1980 to 2000, quantitative research methods were favored by AL researchers; however, from 2001 to 2019, qualitative research methods became increasingly popular.

In addition, other bibliometric analyses have been conducted in AL, but they have primarily focused on a subfield of AL, such as vocabulary research (Meara 2020), translation studies (Dong and Chen 2015a), blended language learning (Li 2022), L2 pronunciation (Demir and Kartal 2022), writing (Crosthwaitea et al. 2022; Sun and Lan 2021), publication fields of specific AL journals. In addition to these bibliometric studies, there is a lack of research on AL paradigms or paradigm evolution. In the context of this chapter, paradigm refers to the fundamental assumptions, concepts, values, and practices that shape AL research. In this chapter, the paradigms of positivism, critical theory, interpretivism, and post-positivism will be used to analyze the AL research paradigms and their evolution over time. For details on the paradigms, please see the section "Classification of Paradigms".

In summary, AL research has experienced major changes since 1990, as new journals have been founded, research has expanded at unprecedented rates, and calls for AL bibliometrics research have intensified (Plonsky 2015; Plonsky et al. 2020). A great deal of conceptual discussions have also raised awareness of the need for a deeper understanding of AL paradigms, making this an exciting time for the AL research community and an opportunity to theoretically advance the discipline (McKinley 2019). However, prior discussions of paradigms and paradigm development within the area of AL have resulted in divergent perspectives, and studies of AL paradigms have uncovered a certain vagueness about them within the research conducted in this area. Therefore, the study presented in this chapter seeks to analyze the paradigms in AL that underpin major research areas and explore their connections to the wider field of HSS. The primary research questions of this investigation include:

1. How have the major areas of AL research developed since their inception?
2. What are the fundamental paradigms that inform the major research areas in the AL field?

This chapter presents a rare empirical study that has utilized bibliometric and data mining methods to examine the advancements in the AL paradigms. It differs from prior bibliometric studies of AL in that it concentrates on paradigms as opposed to research topics, methodologies, and trends, providing further insights.

The remainder of the chapter is structured to fulfill the stated objective. First, we provide the classification of key paradigms, which is commonly used nowadays to refer to a collection of fundamental beliefs underlying HSS research (Crotty 1998; Denzin and Lincoln 2000; Guba and Lincoln 1994). Following an explanation of our research methodologies and procedures, we analyze and discuss the outcomes of the

research. We also consider the implications of using scientometrics and data mining techniques. Finally, we provide concluding thoughts and recommendations for further research.

3 Classification of Paradigms

3.1 Positivism

Positivism is a paradigm of social research methods that dates back to Bacon's empiricism philosophy and Newton's Galilean natural scientific methods (Guba and Lincoln 1994). It is based on the ontology of naïve realism, which holds that reality is absolute, external to the observer, and driven by natural laws (Haack 2003). Quantitative research, adopted by positivism, follows a deductive analysis path (Bergman 2016). It starts from a conceptual model based on theories or early research results and proposes hypotheses about the relationship and conditions of variables, which are then operationalized, quantified, and experimented on (Guba and Lincoln 1994; Kincaid 1996). This linear process, along with the use of value-free methods such as random sampling, statistical processing, and questionnaire development, aims to ensure the objectivity and universality of the conclusions (Bergman 2016; Haack 2003). The goal is to predict, control, objectively describe, and rationally explain behavior, phenomena, or causal relationships (Guba and Lincoln 1994; Kincaid 1996).

3.2 Critical Theory

The term Critical Theory is linked to the Frankfurt School of the 1930s (Kellner and Gennaro 2022). Max Horkheimer and Theodor Adorno of the Frankfurt School articulated an attempt to link philosophical critique and political interpretation through the thought of Marx (Felluga 2015). The critical theory focuses on the upper structure of society, studying the role of ideology and seeking practical solutions to create a more humane society (Bohman 2021). Habermas and McCarthy (1984) argued that there are three types of knowledge interests: the interest in instrumental purpose, the interest in practice, and the interest in liberation.

Studies have highlighted the role of Critical Theory in language education and linguistics research (Flowerdew 2013; Fairclough 2000; Ledin and Machin 2019; Pennycook 2001; Rogers 2008; Weiss and Wodak 2007). Recent studies have demonstrated its value in language teaching, exploring ways to promote social change and challenging power structures (Pennycook 2018). A number of studies have explored the use of critical approaches in language education (Kubota and Austin 2007; Leeman 2014; Pennycook 1999). Critical theory has become an important paradigm in HSS and language education research.

3.3 Interpretivism

Interpretivism is an alternative paradigm of contemporary society that adheres to a subjectivist epistemology (Denzin and Lincoln 2005). It opposes positivism and accepts the involvement of personal opinion in research. This school of social sciences includes constructivism, hermeneutics, phenomenology and symbolic interactionism, with qualitative research commonly used (Leavy 2014). Habermas and McCarthy (1984) suggested that all research should be based on understanding and interpreting the meanings individuals attach to their experiences. Guba and Lincoln (2005) argued for constructivist qualitative research, and Schwandt (1990) suggested hermeneutics to uncover underlying meanings. Interpretivism focuses on understanding and meaningful interpretation rather than explanatory proof, emphasizing personal reflection (Hiller 2016). It also believes reality is localized, multiple and constructed by individuals or societies, and acknowledges the impact of the past on meaning construction (Chipindi et al. 2020). Interpretivism and constructivism are often grouped because they share similar views on the subjective nature of knowledge and the importance of understanding the perspectives of individuals and groups. Both reject the idea of a single objective reality and emphasize that knowledge is socially constructed through people's interactions and experiences (Guba and Lincoln 2005).

3.4 Post-Positivism

Post-positivism is a theoretical pluralism that balances the methods of positivism and interpretivism (Lather 2004). It emphasizes the use of MMR by combining quantitative and qualitative methods to investigate both objective and subjective phenomena (Fischer 1998; Phillips and Burbules 2000; Wildemuth 1993). Historical comparison, philosophy, and phenomenology analysis are also included (Fischer 1998). Post-positivism recognizes that absolute truths are not attainable and instead seeks to explore phenomena as much as possible, advocating for MMR (Guba and Lincoln 1994; Phillips and Burbules 2000; Wildemuth 1993). Although some scholars argue that pragmatism is the best paradigm for MMR (Giddings 2006; Morgan 2007, 2014; Richards 2009), post-positivism has been found to be suitable for MMR in various disciplines, including AL (Creswell et al. 2018; Johnson and Onwuegbuzie 2004). This is evidenced by the successful adoption of mixed methods using post-positivist epistemology in some AL studies (Riazi 2016a; Tabari and Ivey 2015). Furthermore, there are voices that pragmatism is not the philosophical foundation of MMR (Denscombe 2008). Thus, in this chapter, we consider pragmatism as a research orientation parallel to quantitative and qualitative research orientations rather than a philosophical foundation, as advocated by many scholars (Creswell et al. 2018; Onwuegbuzie et al. 2009; Symonds and Gorard 2010; Teddlie and Tashakkori 2012). In this sense, we include pragmatism in the post-positivist paradigm rather

than categorizing it as a separate pragmatism paradigm, and we view the empirical-postpositivist research paradigm as based on quantitative research methods and mixed research methods, while the constructivist-interpretive research paradigm is based on qualitative research methods. This fourfold classification also allows us to compare our research results with those of other HSS paradigms.

4 Methods

4.1 Data Source

A search conducted on 2022.5.29 included 25 AL journals, based on the publication titles used by Lei and Liu (2019b) and Ahmed et al. (2021) included in the Web of Science Categories of "Language & Linguistics" and "Linguistics". However, some titles were excluded due to their absence in the "Language & Linguistics" or "Linguistics" categories, such as Recall, Language Policy, and Language Assessment Quarterly. Additionally, review articles, book chapters, proceedings, and retracted publications were excluded from the study. A total of 23,790 records were retrieved from the Web of Science databases of these journals, which included all articles published since the establishment of each journal with full bibliographic information (see Table 1).

4.2 Bibliometrics Analysis and Mapping of AL Studies

Bibliometrics, scientometrics, and informetrics are data analysis methods used to study research areas through science communication and information, such as publications, references, and citations (Sooryamoorthy 2021). Bibliometrics focuses on publication patterns, citation networks, and co-authorship patterns, while scientometrics analyzes scientific output, such as articles, journals, and institutions (Glänzel and Schubert 2003). In this research, document co-citation analysis was used to identify the scientific communities in a discipline, which involves analyzing how often two documents are cited together (Small 1973). By using statistical techniques like factor analysis, cluster analysis, and multidimensional scaling, important authors and documents can be classified according to their "distance" in the discipline.

Mapping is an analysis technique used to answer questions related to the major research areas, connections between those areas, and the transition of a research field over time (Chen 2017). In order to conduct this rigorous scientific exercise, appropriate scientometric tools are necessary. Two of the most commonly used software tools are VOSViewer and CiteSpace (both freeware) (Dong and Chen 2015b; Chen 2018). A co-citation analysis was conducted in this study to investigate the major research areas in the AL field and the development of the areas chronologically,

Table 1 Publications and articles of dataset

Publication	No. of articles
Lingua	2551
Modern Language Journal	2140
Foreign Language Annals	2081
TESOL Quarterly	1644
System	1378
Canadian modern Language Review	1293
Applied Psycholinguistics	1248
Language Learning	1238
Applied Linguistics	960
International Journal of Bilingual Education and Bilingualism	931
Bilingualism Language and Cognition	863
IRAL	822
Language Teaching Research	711
International Journal of Bilingualism	641
Computer Assisted Language Learning	632
World Englishes	551
ELT Journal	522
English for Specific Purposes	494
Studies in Second Language Acquisition	491
Journal of English for Academic Purposes	474
Cognitive Linguistics	462
Language and Education	462
English Today	429
Journal of Language Identity And Education	418
Journal of Second Language Writing	354

using CiteSpace, a software package able to detect, analyze, and visualize trends in the scientific literature (Chen 2006).

4.3 Detection of Paradigms

4.3.1 Topic Modelling Based on Dictionary

Co-word analysis has been used in this research to map the structure and dynamics of scientific research, assuming that articles using the same term are related on a cognitive level. The network of co-occurrences between different words, extracted from a set of publications, allows a quantitative study of the structure of the publication contents (Tijssen and van Raan 1989). This study used clustering, which is also commonly used by other bibliometric studies.

Although the above-mentioned bibliometric analysis software packages can perform unsupervised research area detection using co-word analysis, our research

adopted a different approach for detecting paradigms. We created our dictionary and used content analysis on the records' abstracts to detect paradigms through topic modelling. However, paradigms are not usually emphasized or even rarely mentioned in the abstract, and content analysis typically only analyzes keywords to identify the research topic (Bryman 2006; Gorard et al. 2004; Crotty 1998). To overcome this limitation and uncover both the explicitly stated and implicitly underlying paradigms in the abstracts, we also utilized topic modelling, which takes into account both manifest and latent dimensions. According to Li and Lei (2021), topic modelling has established itself as an important technique in not only natural and formal sciences but also social sciences. Latent Dirichlet Allocation (LDA), social networks and text analysis are among the topics that are gaining increasing popularity, while certain models (e.g., Probabilistic Latent Semantic Analysis (PLSA)) and applications (e.g., topic detection) are losing their appeal over time (Li and Lei 2021). The specific steps to create a dictionary are as follows.

4.3.2 Dictionary

Content analysis is a research method that involves classifying many words contained in a piece of text into content categories of interest. This requires the development of a coding scheme, a system for classifying text to achieve the objectives of a particular study (Krippendorff 2004). For this research, the content categories were defined as the four paradigms described in the preceding section. The goal was to create a set of reliable and valid indicators of the expression of these four broad categories of paradigms. To do this, the descriptions of paradigms in 79 works (Appendix 1) were coded using QDA Miner (Provalis Research 2020), a qualitative analysis software package.

This study employed a two-step process (Krippendorff 2004) to ensure the accuracy of the dictionaries. First, a keyword-in-context (KWIC) list of words and phrases was generated. Then, a manual examination of thousands of words and phrases was conducted to ensure that the words and phrases funneled into each paradigmatic category truly represented the corresponding paradigm. Ambiguous or incorrect words and phrases were removed from the dictionaries. It is believed that the categories into which each code funneled were able to fully capture the corresponding paradigm in question.

4.4 Identification of Paradigms and Cross-Paradigmatic Comparison of AL Research Areas

We used the dictionary built above to categorize the paradigms of all members of the research area clusters generated from our co-citation analysis. Records that were not included in the major research area clusters after the co-citation analysis were labeled

as 'none'. Wordstat (Provalis Research 2020) was used to cross-tabulate and plot all 23,790 records by research areas and paradigmatic categories.

5 Results

This section focuses on two to three areas that fit our research questions: (1) major AL areas and their development, and (2) the cross-paradigmatic comparison of the areas.

5.1 Major Research Areas in AL

We obtained the major research areas of AL by running CiteSpace, and the cluster visualization view and timeline view of AL research areas are shown in Figs. 1 and 2.

Table 2 presents 12 of the 35 main AL research areas visualized by Citespace based on the clustering labels and the contents of the nodes. For example, Cluster 0, which has 80 pivotal works and a silhouette value of 0.963, is labeled as "second language" by the LLR algorithm, and the mean publication year of the citing articles in this cluster is 1982.

Table 3 shows the pivotal works (most cited works) within each cluster. For example, Cluster 0 includes 1122 citing articles. The major citing article of the cluster is WR, ACTON (1983.0) 2nd language interpersonal-communication – paradigm and praxis. LANGUAGE LEARNING, V33, P23. The most cited works

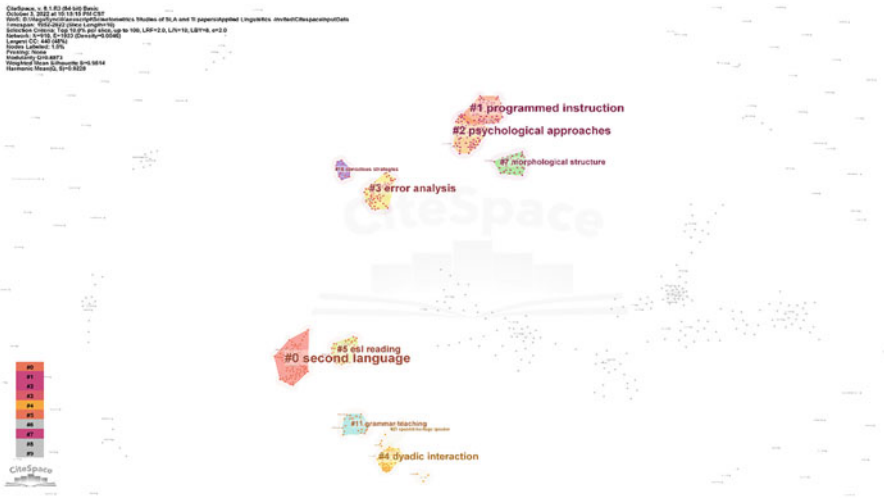

Fig. 1 The co-citation clustering map. (Based on the Title Terms LLR Algorithm)

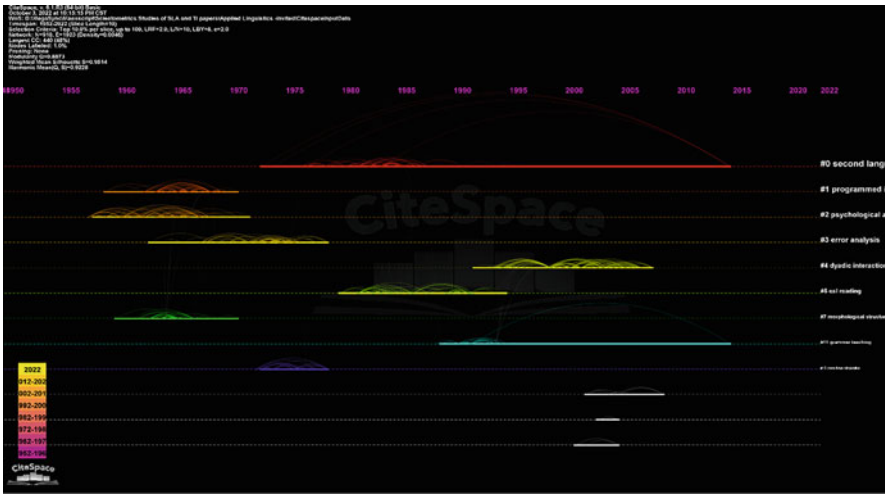

Fig. 2 A timeline map of the co-citation clustering

Table 2 Summary of the largest 12 clusters

Cluster-ID	Size	Silhouette	Label (LLR)	Average Year
0	80	0.963	Second language (1202.45, 1.0E-4)	1982
1	67	0.967	Programmed instruction (699.56, 1.0E-4)	1965
2	60	0.958	Psychological approaches (429.96, 1.0E-4)	1963
3	57	0.966	Error analysis (1033.08, 1.0E-4)	1972
4	48	0.921	Dyadic interaction (1530, 1.0E-4)	1998
5	43	0.979	ESL reading (1564.34, 1.0E-4)	1985
7	32	0.95	Morphological structure (237.02, 1.0E-4)	1964
11	24	0.969	Grammar teaching (746.74, 1.0E-4)	1992
16	14	0.982	Conscious strategies (440.73, 1.0E-4)	1974
21	8	1	Spanish heritage speaker (475.57, 1.0E-4)	2004
29	4	0.995	Corrective feedback (628.76, 1.0E-4)	2003
35	3	1	Task accomplishment (294.55, 1.0E-4)	2001

in this cluster are (the number prior to the works refers to the number of times being cited):

- 220 Halliday MICHAELAK, 2014, COHESION ENGLISH, V0, P0
- 116 Krashen S, 1982, PRINCIPLES PRACTICE, V0, P0
- 101 Krashen SD, 1981, 2ND LANGUAGE ACQUISI, V0, P0

According to the information provided in the visual diagrams (Figs. 1 and 2), this paper analyzes the development and evolution of various research areas in AL over the past 50 years from four different periods.

Table 3 Information of the most cited works within each cluster

Cluster	3 most cited works	Major citing article	Total citing articles
0	220 Halliday MICHAELAK, 2014, COHESION ENGLISH, V0, P0 116 Krashen S, 1982, PRINCIPLES PRACTICE, V0, P0 101 Krashen SD, 1981, 2ND LANGUAGE ACQUISI, V0, P0	WR, ACTON (1983.0) 2nd language interpersonal-communication – paradigm and praxis. LANGUAGE LEARNING, V33, P23.	1122
1	55 Chomsky NOAM, 1968, SOUND PATTERN ENGLIS, V0, P0 18 King RD, 1969, HISTORICAL LINGUISTICS, V0, P0 18 Rivers WM, 1964, PSYCHOLOGIST FOREIGN, V0, P0	LA, JAKOBOVITS (1969) Research findings and foreign language requirements in colleges and universities. FOREIGN LANGUAGE ANNALS	215
2	63 Chomsky N, 1965, ASPECTS THEORY SYNTA, V0, P0 15 Jakobovits LA, 1970, FOREIGN LANGUAGE LEA, V0, P0 15 Katz JJ, 1964, INTEGRATED THEORY LI, V0, P0	JW, OLLER (1969.0) Conceptual restrictions on English – psycholinguistic study. LINGUA, V23, P24.	177
3	59 Selinker L, 1972, IRAL-INT REV APPL LI, V10, P209 32 Brown R, 1973, 1 LANGUAGE, V0, P0 30 Bailey N, 1974, LANG LEARN, V24, P235	J, CHUN (1980) A survey of research in 2nd language acquisition. MODERN LANGUAGE JOURNAL, V64, P10.	306
4	52 Norris JM, 2000, LANG LEARN, V50, P417 48 Skehan P, 1998, COGNITIVE APPROACH L, V0, P0 45 Schmidt RW, 2001, COGNITION 2 LANGUAGE, V0, P3	ROD, ELLIS (2006) Reexamining the role of recasts in second language acquisition. STUDIES IN SECOND LANGUAGE ACQUISITION, V28, P26.	443
5	68 Omaggio AC, 1986, TEACHING LANGUAGE CO, V0, P0 52 Oxford RL, 1990, LANGUAGE LEARNING ST, V0, P0 41 Gardner R, 1985, SOCIAL PSYCHOL 2ND L, V0, P0	RM, DEKEYSER (1993) The effect of error correction on l2 grammar knowledge and oral proficiency. MODERN LANGUAGE JOURNAL, V77, P14.	435

(continued)

Table 3 (continued)

Cluster	3 most cited works	Major citing article	Total citing articles
7	21 Lyons J, 1968, INTRO THEORETICAL LI, V0, P0 12 Fillmore CJ, 1968, CASE, V0, P0 8 Halliday MAK, 1961, WORD, V17, P241	SC, DIK (1967) Some critical remarks on the treatment of morphological structure in transformational generative grammar. LINGUA, V18, P32.	435
11	50 Chaudron C, 1988, 2ND LANGUAGE CLASSRO, V0, P0 34 Phillipson ROBERT, 1992, LINGUISTIC IMPERIALI, V0, P0 27 Peirce BN, 1995, TESOL QUART, V29, P9	RP, LEOW (1998) The effects of amount and type of exposure on adult learners' l2 development in SLA. MODERN LANGUAGE JOURNAL, V82, P20.	267
16	38 Gardner RC, 1972, ATTITUDES MOTIVATION, V0, P0 21 Krashen SD, 1976, TESOL QUART, V10, P157 14 Brown HD, 1973, LANG LEARN, V23, P231	E, BIALYSTOK (1978) Variables of classroom achievement in 2nd language-learning. MODERN LANGUAGE JOURNAL, V62, P10.	98
21	31 Ellis R, 2005, STUD SECOND LANG ACQ, V27, P141. 30 Montrul S, 2004, BILINGLANG COGN, V7, P125 30 Dekeyser R, 2003, HDB 2 LAN	SILVINA, MONTRUL (2009) Reexamining the fundamental difference hypothesis, what can early bilinguals tell us? STUDIES IN SECOND LANGUAGE ACQUISITION, V31, P33.	150
29	37 Chandler J, 2003, J SECOND LANG WRIT, V12, P267. 35 Ferris DR, 2003, RESPONSE STUDENT WRI, V0, P0 34 Ferris DR, 2004, J SECOND LANG WRIT, V13, P49.	NIGEL, Harwood et al. (2009) Proofreading in a UK university: proofreaders' beliefs, practices, and experiences. JOURNAL OF SECOND LANGUAGE WRITING, V18, P25.	69
35	26 Ohta AS, 2001, 2 LANGUAGE ACQUISITION, V0, P0 23 Markee N, 2000, CONVERSATION ANAL, V0, P0 21 Markee N, 2004, MOD LANG J, V88, P491.	L, MONDADA (2005) Second language acquisition as situated practice: task accomplishment in the French second language classroom. CANADIAN MODERN LANGUAGE REVIEW-, V61, P30	49

In the period 1955–1970, AL research focused on several key areas represented as clusters 1, 2, 3, and 7. The major research in Cluster 1 centers around foreign language requirements in colleges and universities and their relationship to research findings. Chomsky and Halle (1968) look at the theoretical foundations of phonology, King (1969) examines the history of language and its evolution, and Rivers (1964) looks at the psychological factors that affect foreign language learning. Cluster 2 focuses on the study of language and its acquisition, with Oller and Dennis Sales (1969) examining the limitations and restrictions of conceptual knowledge in language acquisition and Chomsky (1965) looking at the theoretical foundations of aspects and the relationship to the study of language. Jakobovits (1970) and Katz (1964) also focus on the process of language acquisition and the role of different factors in this process. In Cluster 3, the major research centers around the field of second language acquisition (SLA), with Chun (1980) providing an overview of the state of research in SLA at the time and Selinker (1972) examining the concept of interlanguage. Brown (1973) and Bailey et al. (1974) also focus on the process of language acquisition and the different factors that influence it. Cluster 7 emerged during this period, with Lyons (1968) providing an overview of the field of theoretical linguistics and its relationship to the study of language, and Fillmore (1968) and Halliday (1961) examining the morphological structure of language and the different elements that make up a word.

In the period of 1970-late 1980s, SLA represented by cluster 3 continued as a major research area while clusters 0 and 16 emerged as new major research areas. Cluster 0 focuses on the study of language, interpersonal communication, and language acquisition, with Acton (1983) examining the relationship between language and communication and the implications of this relationship for language learning. Halliday and Hasan (2014) examine the ways in which language is used to create cohesion and coherence in written and spoken discourse, and Krashen (1981, 1982) focuses on the process of language acquisition and the role of input and affective factors in this process. Cluster 16 emerged during this period, with a focus on variables that affect classroom achievement in second language learning. Bialystok and Fröhlich (1978) examine these variables. Gardner and Lambert (1972) look at the role of attitudes and motivation in second language acquisition. Krashen (1976) examines the role of input and affective factors in second language acquisition. Brown (1973) looks at the process of language acquisition and the factors that influence it.

In the period of 1990–2005, while the study of language, interpersonal communication, and language acquisition (represented in Cluster 0) remained a key research interest, clusters 4, 5, 11, 21, 29, and 35 represent the various new research areas that emerged in this period. Cluster 4 centers around the role of recasts in second language acquisition, as highlighted by Ellis and Sheen (2006) in their examination of the role of recasts and the need for further research in this area. Norris and Ortega (2000) also examine the role of input and output in language acquisition. Skehan (1998) looks at the cognitive processes involved in second language acquisition. Schmid (2001) examines the role of cognitive factors in second language acquisition. Cluster 5 focuses on the effect of error-correction on second language grammar

knowledge and oral proficiency as highlighted by DeKeyser (1993) in his examination of the effect of error-correction, Omaggio (1986) looks at the methods and techniques of teaching language in context, Oxford (1990) examines the strategies used by language learners to acquire a second language, and Gardner (1985) looks at the role of social factors in second language acquisition. Research in Cluster 11 mainly examines the relationship between language and communication, the role of context in language use (Leow 1998), the importance of cohesion in written and spoken discourse, and the process of language acquisition (Chaudron 1988), and the role of input and affective factors in this process (Peirce 1995). The research in Cluster 21 focuses on the fundamental difference hypothesis (FDH) and the study of early bilingualism. The research in this cluster suggests that the FDH is not supported by the evidence from the study of early bilinguals and that other factors may be more important in bilingualism. Montrul (2009) challenges the FDH's claim that early bilinguals have a fundamentally different cognitive and linguistic system compared to late bilinguals.

Other notable works in this cluster, such as Ellis (2005), Montrul (2004), and DeKeyser (2003), also provide evidence against the FDH and explore other factors that may play a role in bilingualism, such as explicit instruction and implicit learning, and age. The major research area represented by Cluster 29 focuses on the beliefs, practices, and experiences of proofreaders in UK universities, as represented by Harwood et al. (2009). Other important works include Chandler (2003) and Ferris (2003, 2004). Cluster 35 focuses on second language acquisition as situated practice, as represented by Mondada and Doehler (2005), with relevant and notable works including Ohta (2001), Markee (2000), and Markee and Kasper (2004), which also examine the importance of context, input, and interaction in language learning, and use of conversation analysis in understanding language use and social interaction.

In the period of 2005–2015, it seems that AL research continued to focus on several key areas represented in Clusters 0, 4, 11, and 21. However, they all came to an end in around 2015. As this study only plotted the 12 most influential AL research areas, research areas that are less prominent than the top 12 during this period are not shown in Figs. 1 and 2, indicating that the potential new and influential AL research areas are yet to form.

In fact, with continuous expansion and diversity, some key research areas that emerged after 2015 include the use of technology in language learning (Farr and Murray 2016; Shannon and Chapelle 2017), the study of multilingualism (Martin-Jones and Martin 2017; Gorter and Cenoz 2017), the use of corpus-based methods (Un-udom and Un-udom 2020; Yin and Li 2021; Szmrecsanyi and Rosseel 2020), the study of language assessment (Giraldo 2018; Glenn Fulcher 2021), the use of discourse analysis (Slembrouck 2019; Zotzmann and O'Regan 2016), and the study of language and identity (Zotzmann and O'Regan 2016; McEntee-Atalianis 2019; Zenker 2018; Pérez-Milans 2016). The research areas in the field of AL continue to evolve and expand, reflecting the dynamic and multifaceted nature of the field.

It's worth noting that the clusters in each period are not mutually exclusive, and there may be some overlap between them (as shown in Fig. 2). Additionally, it's

important to keep in mind that the works cited in each cluster are not exhaustive, and there are likely many other important works and research areas within each cluster. Furthermore, the clusters identified and the periods assigned to them are based on the information provided in the question and may not fully capture all the nuances and complexities of the field of language research.

5.2 *Cross-Paradigmatic Content Analysis of the Themes*

We classified all documents into 12 major clusters and determined the paradigm of each cluster according to a dictionary. The results, shown in Fig. 3, reveal that the positivist paradigm is the most dominant across major research areas. Clusters 1, 2, 3, 4, 5, 7, 16, 21, 29, and 35 all fall under this paradigm. As shown in Fig. 2, Clusters 1, 2, 3, 7, and 16 were major research areas before 1980, while clusters 4 and 5 were dominant between 1980 and 2005. Clusters 11, 21, 29, and 35 were the main research areas from 2005 to 2015. Our findings indicate that positivism dominated the early period of AL research (1955–1970), with four major research areas falling under this paradigm. Positivism slightly decreased during 1975–1990, with only one major research area (cluster 5) having a clear positivist character. However, it returned to dominance between 1990 and 2015, with five major research areas (clusters 4, 5, 21, 29, 35) showing characteristics of positivism.

Figure 3 also shows that cluster 0, which has the largest timespan in Fig. 2, is far away from any paradigm, indicating that this main research area, which focuses on the study of language, interpersonal communication, and language acquisition, is

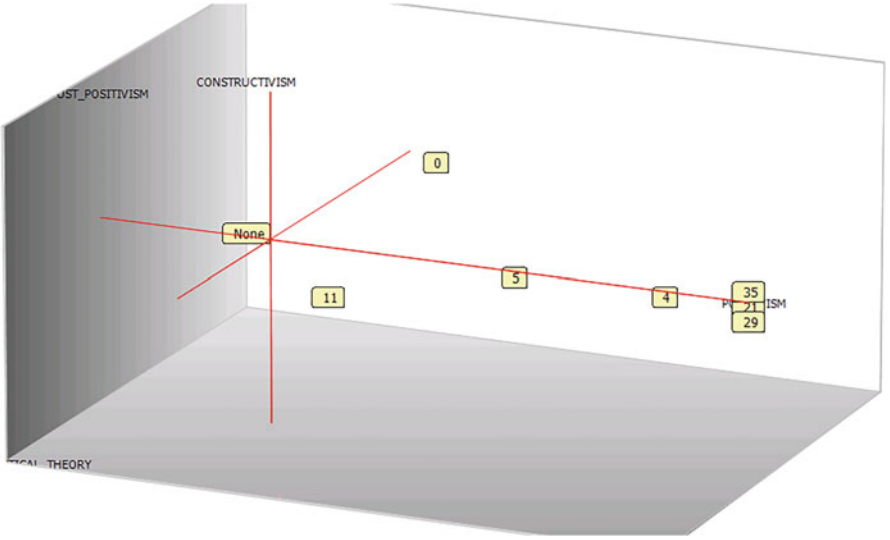

Fig. 3 Cross-tabulation of clusters and paradigmatic categories

difficult to fit into any of the four paradigms. The "none" cluster, with the largest members, is furthest from positivism, and the distances between it and post-positivism, constructivism, and critical theory are about the same, showing that most of the paradigms or methods of AL research in this cluster do not have the characteristics of positivism, but prefer post-positivism, constructivism, and critical theory and other paradigms. However, the "none" cluster is at the origin of the 3-D coordinate system of Fig. 3, which also indicates that the vast majority of AL studies included in the cluster may not have a clear paradigm tendency.

Cluster 5, one of the major research areas of AL from 1990 to 2005, is not far from the positivist paradigm, but there is a clear tendency to depart from it. This cluster centers around the effect of error correction on second language grammar knowledge and oral proficiency and is more in line with the general understanding that error analysis, proficiency tests and other measurements are carried out with a positivist approach. Cluster 11 is a major AL research area spanning 25 years from 1990 to 2015. It also seems to detach from the positivist paradigm, with weak Critical theory characteristics. As Cluster 11 centers around factors that impact second language acquisition, including the factor of language policies on second language development (Phillipson 1992), it is understandable that such social issues are addressed with the critical theory approach.

6 Discussions and Implications

To address RQ 1, our results show that AL has evolved over time, with key areas of focus shifting from foreign language requirements and psychological factors in language learning in the 1955–1970s to interpersonal communication and language acquisition in the 1970s and 1980s and then to technology, individual learner differences, and language and culture in the 1990s–2005. After 2015, research in AL continued to expand and diversify with a focus on technology, multilingualism, corpus-based methods, language assessment, discourse analysis, and language and identity. Importantly, our research results align with those of Lei and Liu (2019a) and Lin and Lei (2020), who also found that popular topics during the 2005–2016 period included the impacts of socioeconomic class, ideology, and globalization on language use and identity, the development and use of English as a Lingua Franca, the practice and effects of multilingualism, and corpus-based investigations of field-specific discourse and literacy practices.

One key difference between our results and those of Lei and Liu (2019a) and Lin and Lei (2020) is that our results focus on the evolution of research areas over a longer period, while the other researchers focus on specific periods. Additionally, while our results indicate a shift towards technology and multilingualism in recent years, Lei and Liu (2019a) and Lin and Lei (2020) focus on specific popular research topics within these areas. Another difference is that our research results also indicate that after 2015, AL research continued to expand and diversify, while Lei and Liu (2019a) and Lin and Lei (2020) did not mention this.

Addressing RQ 2, our results show that the dominant paradigm in AL research from 1955–2015 was positivism, with four major research areas falling under this paradigm in the early period of 1950–1970 and five major research areas showing positivist characteristics between 1990–2015. However, the longest and major research area in AL, focusing on language, interpersonal communication, and language acquisition (Cluster 0), does not fit into a clear paradigm. Two other major research areas from 1990–2015 show a departure from positivism, with one focusing on measurements and the other showing weak characteristics of critical theory.

Our results suggest that four paradigms tend to be coexistent in AL research, indicating that they appear to compete with rather than replace one another. This finding is in line with other researchers' views, which suggest that in HSS, as in any subject, paradigms mean answers to three philosophical questions, namely, ontology, epistemology, and methodology (Guba and Lincoln 1994; Creswell et al. 2018; Bettis and Gregson 2001). Our findings also support the view that although HSS fields lack a unified paradigm in general, it does not mean that there is no paradigm (Holliday and Macdonald 2020) and that, in fact, new and old, and different paradigms (or schools) can coexist in mutual competition (Laudan 1996; Giddens 1986).

Our results indicate that the dominant paradigm in AL research from 1955–2015 was positivism, with four major research areas falling under this paradigm in the early period and five major research areas showing positivist characteristics between 1990–2015. This is similar to Meihami (2020) and Amini Farsani et al. (2021), who found that the most prevalent research approach in AL was quantitative. However, it should be noted that our results also indicate that the longest and major AL research area of language, interpersonal communication, and language acquisition does not fit into a clear paradigm. Our results also indicate that two major research areas from 1990 to 2015 tend to depart from the positivist paradigm, with one of them showing weak characteristics of critical theory. In contrast, Meihami (2020) and Farsani et al. (2021) did not specifically analyze research paradigms but rather the methodological orientations used in AL. Therefore, while there is some overlap in terms of the use of quantitative methods in positivist research and the field of AL more broadly, our results also highlight a more nuanced picture of the paradigms used in the field over time.

Our findings show that certain main research areas of AL do not align with any paradigm, with the "none" cluster showing a preference for post-positivism, constructivism, and critical theory, yet lacking a clear tendency. Additionally, major research areas of AL from 1990 to 2005 and 1990 to 2015 also tend to diverge from the positivist paradigm. This supports the viewpoint that the supposed shift to post-positivism in AL is not accurate (Yüce et al. 2014). Yüce et al. (2014) specifically demonstrate that experimental and descriptive research designs are still prevalent, indicating that the dominant paradigm in AL research is positivism, with other paradigms barely present. Our finding that there are paradigms present in AL research and that there has been a slight shift in paradigms contradicts the claims that there is no paradigm or paradigm shift in AL research (Corson 1997). This may

alleviate concerns raised by some researchers about a lack of paradigm awareness in AL research (Benton and Craib 2011; Berkovich 2018; Christopher 2017).

Our results, which show that the majority of studies in the "none" cluster are furthest from positivism, should not be interpreted as evidence that AL research has abandoned positivism in favor of interpretivism and critical theory paradigms, as claimed by some researchers (Torabi 2011; Risager 2011; Weideman 2013a; Jacobs and Farrell 2001). This may be due to a lack of mention of the research paradigm or a lack of clear description of the research method in the studies analyzed. Pederson (2006), Corson (1997), and Ortega (2012) have all argued that many AL researchers focus too heavily on the methodological aspects of their research rather than its philosophical foundations. As a result, it is not easy for readers to identify research paradigms due to a lack of critical analysis of paradigmatic assumptions by the researchers. Additionally, as this study only analyzed abstracts, which are often limited in word count, it is possible that the text describing research paradigms was not captured.

7 Implications for Scientometric Studies

In this research, scientometric methods were employed to identify research areas and trends in AL. The most used scientometric methods for identifying research areas and trends are co-word clustering and co-citation clustering. Citespace was used due to its specialized ability to analyze bibliographic information and its co-citation function to identify the major research areas of AL with more precise results than those of co-word clustering. Several methodological advantages of our scientometric review over a conventional review can be argued.

Firstly, co-word clustering is a common clustering analysis available in most scientometric software packages. However, due to the limited number of words in the abstract, some paradigmatic related words may appear less frequently than other academic terms or professional terms and thus cannot be presented with significance. Furthermore, researchers may not describe paradigms clearly or not describe them at all, which could potentially affect the identification results if co-word clustering is used. Therefore, our research employed data mining methods to establish a dictionary model (Four paradigms model) with the extensive discussion of paradigms in existing literature as the data. As far as we know, none of the existing bibliometric studies in AL research has used similar methods, and this is the contribution of our research to scientometrics, i.e., bibliometric data can be combined with content analysis to achieve a greater effect.

Our study used a dictionary model to classify 23,790 datasets, cross-tabulating the research area variable (cluster membership) and the paradigmatic variable (category of paradigms) to produce a 3-D projection map. This is the first time such a map has been created in AL, thus providing new insights into AL research. Furthermore, bibliometric software can usually be used to cross the identified research areas with temporal variables or geographic coordinate variables to generate

timeline projection maps or geographic distribution maps of research areas; however, they are generally unable to generate such cross-tabulations without the use of custom codes written by researchers. Our study reveals the potential for further exploration of research areas and paradigmatic transformation.

8 Implications for AL Studies

Our analysis indicates that while there has been some paradigmatic change in the AL research community since the 1950s, this change has not significantly manifested itself in research papers. This may be due to a variety of factors, such as the persistence of disciplinary traditions or the difficulty in operationalizing new paradigms in research practice, highlighting the need to explore these factors and their implications for the AL field. Our analysis also shows that in most AL research areas, positivism maintains its prevailing, dominant position. This could have implications with respect to pluralists and general researchers. As Riazi (2016a) asserted, one way to address this issue is to consider a research problem from two theoretical underpinnings. If the AL field were to become a pluralist discipline (Weideman 2013b), the long-term advocacy for pluralism would need continuous and stronger endeavors. The empirical evidence shown in this study suggests that while there are signs of the emergence of post-positivist, constructivism or critical theory in AL research, their influences are still rather insignificant, particularly given that researchers are often vague about their paradigmatic positions (Bryman 2006; Hashemi 2019). Therefore, when reporting their research, researchers should consider the paradigmatic dimensions and philosophical positions of their research and choose a research design that aligns with their research questions and goals. Although movements away from a positivist paradigm in the AL community since 1990 might include the rise of critical theory, which emphasizes the role of power and ideology in language use, or the increased focus on the social and cultural contexts of language learning and use in sociocultural theory, these movements have not yet significantly displaced the positivist paradigm in the AL field, highlighting the need for ongoing effort towards pluralism. To ensure a long-lasting influence, pluralist researchers will need a stronger commitment and continuous effort.

The findings of our study suggest that it is crucial for researchers to carefully consider their paradigmatic dimensions and philosophical positions of ontology, epistemology, and methodology when reporting their research specifically, for quantitative researchers interested in exploring post-positivist paradigm issues, MMR, which leans towards quantitative methods, maybe a better research design. This is a serious consideration, as the choice of research design can impact the outcome and interpretation of the research findings. Furthermore, it is important to note that MMR can be particularly valuable for critical research and innovative perspectives. Therefore, this issue warrants further attention and consideration in the field of AL research.

8.1 Limitations

This study focuses on identifying the paradigms that are prevalent in AL. However, several limitations should be noted to avoid potential misinterpretations. Firstly, as we used quantitative methods, the data used for this study is based on a sample of 23,790 AL papers collected from the Web of Science database, including numerous references cited in these papers. We used co-citation clustering to identify important research areas within AL. It should be noted that papers that are grouped in the same cluster are largely determined by the references cited by the authors of the papers.

In addition, it is important to note that while this study analyzed 12 major clusters within AL, these clusters represent only a small portion of the 23,790 AL papers included in the study. The papers that did not belong to these clusters were classified as "none cluster." This clustering method may have caused bias in the results as the text used for analysis was limited to the 12 research areas identified. Therefore, it is possible that the true evolution of AL research paradigms may not be fully reflected in our findings as the abstracts of the papers used in the study may not provide enough information to draw definitive conclusions about the paradigms used in the research. Future research using co-word clustering may reveal a greater diversity of AL paradigms, but it is also important to consider that co-word clustering is still subject to bias due to the subjective nature of abstract and keyword writing.

Furthermore, our dictionary also has some impact on the research results. Because there are relatively few philosophical discussions in AL, the related texts used to establish the dictionary model are all from the philosophical discussions of some other fields, such as education and social science. If the philosophical discussions of the field of AL increase in the future, extracting keywords from these discussions to make a dictionary model may obtain more accurate results.

Lastly, our classification of paradigms is based on Guba and Lincoln's (1994) category; as other scholars point out, there is no unified classification method for paradigms in AL. Different researchers may use different paradigm classification methods. Therefore, we can only say that our research results reflect the development and evolution of paradigms in AL using this paradigm classification method.

9 Conclusions

This study has provided a comprehensive overview of the development of major AL research areas over the past six decades. It reveals that the dominant paradigm in AL is positivism, characterized using empirical methods such as quantitative, qualitative, and MMR. Although the presence of the remaining three paradigms in AL research is weak, they have been identified as coexisting in the field. This finding highlights the ongoing paradigm war in the AL community and supports the argument in the literature that various paradigms coexist and compete with one another in scientific research (Riazi 2016a). Further research should investigate the

implications of this paradigmatic competition and coexistence in AL research and explore the potential benefits of a more pluralistic approach.

The use of a dictionary model to classify 23,790 pieces of data has provided new insights into AL research. This is the first time a data mining method has been combined with bibliometric methods in AL, contributing to scientometrics. The study highlights that postmodernism, which originated in Western humanism and Anglo-American scientism in the 1970s, has had a significant influence on AL research. This influence has led to the evolution of paradigms in the field, providing a new perspective and direction for its advancement. The findings of this study underline the importance of understanding the paradigms that inform AL research, as well as the need for further research to explore their implications for the field.

In conclusion, this chapter highlights the dominance of the positivist paradigm in AL research and the coexistence of other paradigms. Researchers can benefit from a deeper understanding of these paradigms, leading to more effective research designs and clearer reporting of results. The coexistence of multiple paradigms emphasizes the importance of open-mindedness and flexibility in approaching research questions and interpreting findings. As the field of AL continues to evolve, embracing a diversity of perspectives and approaches will be critical for a stronger and more cohesive research community.

Appendices

Appendix 1 Coded Works on Paradigms

Aliyu-2015
Allwright 2005 – Developing Principles for
Barnes 1969 – Paradigms-scientific and social
Bednarek 2006 – Epistemological positioning
Bhavnan-2014
Brown 1982 – Paradigms and revolutions
Butler 1978 – Epistemology in the language
Case 1998 – Changing Views of Knowledge
Clarke, Losoff et al. 1984 – Linguistic relativity
Cleland-2015
Corson, David 1997 – Critical Realism
Creswell 2018 – Designing and Conducting
Creswell 2018-Philosophical foundations
Crotty 1998
Denzin & Lincoln 2005 – Introduction
Deumert 2003 – Bringing speakers back in
Dewaele 2005 – Investigating the Psychological
Dieronitou 2014 – The ontological and epistemological foundations

(continued)

Dryzek 2012 – Paradigms and discourses
Fazliogullar 2012 – Scientific research
Fishman 1984 – Epistemology
Gert 2001 – Hobbes on language
Gontier, van Bendegem et al. (Ed.) 2006
Gray-Doing research
Gregg 1987 – Communication epistemology
Guba & Lincoln 1994
Guba Lincoln 2000
Guba-1990
Hinkel, E._2016 -Int
Jalali, Ghadiri et al. 2021 – Epistemic Features
Kern, Schultz 2005 – Beyond Orality
Kubota 2020 – Confronting Epistemological
Lather-2004
Lillis, Scott 1997 – Defining academic literacies
Luck, Jackson et al. 2006 – Case study
Madill−2000
Magnan 2005 – From the Editor
Maingard 1999 – Evolutionary epistemology
McDonagh 1976 – Attitude changes and Morato – 2019
Morgan-1980
Mori 1999 – Epistemological Beliefs
Orman 2016 – Paradigm as a central
Ortega 2005 – For What and for Whom
Ortega 2005 – Methodology
Ortega 2012 – Epistemological diversity
Ortega 2018 – Ontologies of language
Pascal −2016
Pederson 2006 – Epistemologies and research
Pennycook 2018 – Transdisciplinarity in Applied
Peterson, L 1981 – Historical self-understanding
Rancourt 1983 – Epistemology
Reagan 1999 – Constructivist Epistemology and
Riazi 2016 – Innovative mixed-methods research
Riazi, Candlin 2014 – Mixed-methods research
Rothman 2008 – Poverty-of-the-Stimulus and
Schwandt 1990 – Paths to inquiry
Schwartz 1986 – The epistemological status of
Scotland 2012 – Exploring the Philosophical
Shah, Al-Bargi 2013 – Research Paradigms
Shin 2006 – Rethinking TESOL
Slevitch-2011
Spada 2005 – Conditions and Challenges

(continued)

Spencer-2014
Staller –2013
Strong – 1976
Tang 2011 – Foundational paradigms of
Thomas, Suleiman 2019 – Thomas Kuhn's
Thorne 2005 – Epistemology
Toohey 2019 – The Onto-Epistemologies of
Torabi 2011 – Philosophy of Research in
Tresch 2001 – On going native
Tsai 2006 – On the Epistemology of Language
Tuli-2011
Wagner 2019 – Towards an Epistemology of
Watson-Gegeo 2004 – Mind, Language
Wierzbicka 1994 – Semantics and epistemology
Yearley 1988 – Argumentation
Younas, Parsons 2019 – Implications for

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Bailey, Nathalie, Carolyn Madden, and Stephen Krashen. 1974. Is there a "natural sequence" in adult second language learning? *Language Learning* 24 (2): 235–243. https://doi.org/10.1111/j.1467-1770.1974.tb00505.x.

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Research Trends in Applied Linguistics (2017–2021): A Scientometric Review of 42 Journals

Yanhua Liu and Guangwei Hu

1 Introduction

Applied linguistics can be broadly defined as a discipline that studies "language with relevance to real-world issues", according to the stated aims of its flagship journal, *Applied Linguistics* (2022). The recent decades have witnessed its fast growth in terms of the number of papers published every year, the topics examined, and the emergence of new theories, approaches, methodologies and perspectives as a result of its increasing interactions with other disciplines and the real world. It is challenging for researchers, particularly novice ones seeking entry into the discipline, to keep up with the ever-growing scholarly literature. A solution is to utilise scientometric methods to identify research trends based on bibliographic information in a representative body of the scholarly literature.

Originally developed by information scientists, scientometric methods such as citation analysis, document co-citation analysis, and author co-citation analysis have now been widely used to provide historical as well as state-of-the-art accounts of research in a discipline (Chen and Song 2017; Hood and Wilson 2001). Within applied linguistics, scholars have recently adopted such methods to detect the developments and research trends of the whole discipline (e.g., Lei and Liu 2019) and its sub-disciplines such as second language acquisition (Zhang 2020), English for specific purposes (Hyland and Jiang 2021; Liu and Hu 2021), and translation

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studies (Zhu and Aryadoust 2023). There are also journal-based reviews, such as Riazi et al.'s (2020) investigation of the *Journal of English for Academic Purposes,* though such reviews are based on content analysis rather than scientometric methods. Lei and Liu's (2019) pioneering scientometric analysis of papers published from 2005 to 2016 in 42 SSCI-indexed applied linguistics journals is directly relevant to our study. Their analysis has yielded useful insights into the historical and emerging trends in applied linguistics. Since 2016, the field has seen many new developments, such as the surging interest in translanguaging and emotions of foreign language learning and methodological innovations. To build on Lei and Liu (2019), we aim to track the latest research trends in the discipline by examining papers published between 2017 and 2021 in the same 42 journals. Thus, our study is intended to provide an updated overview of the discipline by focusing on the changing/unchanged research foci and methodological orientations and identifying new movers, shakers, and innovators in the discipline.

1.1 Scientometric Methods

Scientometrics is the study of "all quantitative aspects of the science of science, communication in science, and science policy" (Hood and Wilson 2001, 293). In a narrower sense, scientometrics (also known as "bibliometrics") refers to the use of statistical and computational methods to study the scientific literature so as to develop knowledge about a chosen discipline, specialty, or research area. Contemporary scientometric methods are built on the work of information scientists such as Eugene Garfield (1955), who created the Science Citation Index (SCI) to provide comprehensive bibliographic information of science journal articles and the bedrock for the development of most commonly used scientometric methods such as co-citation analysis.

Co-citation analysis as a scientometric method was pioneered by Small (1973), who defined co-citation as the frequency of a pair of earlier documents cited together by a later document. In other words, co-citation analysis involves counting the number of subsequent documents that cite the same pair of earlier documents in their reference lists. According to Small, two documents are likely to be related if frequently cited. This means that they may address similar research topics and/or use similar methods. It has thus been well-established by scientometric scholars (e.g., Chen et al. 2010, Small 1973; Small and Griffith 1974) that highly co-cited pairs of documents form clusters that represent the knowledge structure (i.e., research themes or areas) of a discipline or a research area which are subject to change as new discoveries are made, and new theories or methods are introduced. Therefore, co-citation analysis, particularly document co-citation analysis, can provide useful insights into the research trends and patterns of a discipline.

Other scientometric methods, such as analyses of keywords and cited authors based on frequency information, can also reveal important information about the research patterns of a discipline (Lei and Liu 2019; Zhang 2020). The keywords

supplied by the author(s) or extracted from the abstracts can point to the most frequently discussed topics. Based on the frequency of the cited authors, it is also possible to gauge the level of interest in different research topics and identify the leaders in the discipline (de Bot 2015; Lei and Liu 2019).

2 Scientometric Reviews of Applied Linguistics Research

Scientometric methods have been applied to studying research trends in various disciplines. While Swales (1986) first introduced citation analysis to applied linguistics in 1986, efforts to apply scientometric methods in the discipline were quite scarce until much recently. In one of the earliest efforts, Meara (2012) demonstrated how his analysis of 101 co-cited authors in vocabulary research could help track diachronic changes in a small field such as L2 vocabulary acquisition.

A few recent studies have focused on applied linguistics as a discipline or its sub-disciplines. Amini Farsani et al.'s (2021) study of about 4000 applied linguistics articles from 18 leading journals published during 2009–2018 revealed that systematic reviews received significantly more citations than articles of other methodological orientations (i.e., quantitative, qualitative, and mixed methods). Based on document co-citation analysis, Liu and Hu (2021) identified 11 major clusters of co-cited works that represented important areas of English for specific purposes research and were constitutive of the field's three evolutionary stages. Focusing on second language acquisition (SLA), Zhang (2020) examined research published in 16 journals between 1997 and 2018 based on three types of analysis (citation analysis of impact, co-citation analysis and keyword analysis). Through keyword analysis, key SLA topics such as bilingual advantage, collaborative writing, cognitive control, and dynamics system(s) have been found to have gained significant interest in the past 20 years. The study also found from the most cited articles that topics in bilingualism and the meta-analytic method have become popular in the last decade (2008–2017). In terms of theories, sociocultural theory and complexity theory have been highlighted as gaining momentum in the field. The last finding echoes de Bot's (2015) observations of the trends in applied linguistics between 1980 and 2010. de Bot's (2015) book-length review of the discipline adopted a combination of professional opinions from interviews and surveys with about 100 applied linguists and a citation analysis of the informants' three most cited publications in terms of h-values and total citations. It was found that Krashen, Crystal, R. Ellis, Swain, Bachman, and Oxford were some of the leading applied scholars in terms of citation counts.

Most relevant to our study, Lei and Liu's (2019) study focused on the most frequently discussed topics, the most highly cited documents and authors, the most productive countries/regions, as well as diachronic changes from 2005 to 2016. They reported that the impact of socioeconomic class, ideology, identity, ELF, multilingualism, and corpus-based investigations were among the most popular topics. The study also suggested that the increasing member of publications from non-Anglo

countries such as China may have contributed to more discussion of issues specific to local contexts. Since the study was based on data collected up to 2016, research published thereafter may have introduced new topics, perspectives and methodological choices. Based on the new research published after 2016, our study aims to trace the latest developments in the discipline in terms of major topics; most cited publications and authors. Specifically, we formulated three questions:

1. What have been the most frequently discussed topics in the 42 applied linguistics journals from 2017 to 2021?
2. Which publications are the most highly cited in the surveyed applied linguistics articles?
3. Which authors are the most highly cited in the surveyed applied linguistics articles?

By addressing these questions, our study complements existing reviews by highlighting the increased methodological awareness and new movers, shakers, and innovators in the discipline.

3 Methodology

3.1 Dataset

The dataset for our study comprises 7602 applied linguistics articles with 198,861 unique references from 42 applied linguistics journals published between 2017 and 2021 (see Table 1). We chose the same journals examined by Lei and Liu (2019) not only because these are journals of high impact and deemed representative of the discipline[1] but also because they would enable us to make diachronic comparisons to track the (un)changing research trends in applied linguistics. Our dataset included empirical articles (operationalized as studies with their data), review articles, and conference proceeding papers but excluded other document types such as book reviews and editorial matters. Articles that were published online first without being assigned to an issue during this period were also excluded. The bibliographic data of the sampled articles were downloaded from the Web of Science in January 2022 for subsequent processing.

[1] Lei and Liu (2019) selected the 42 journals based on three criteria: (1) focusing on language use and learning or teaching, (2) being on the SSCI list of linguistics journals, and (3) having an impact factor of at least 0.25.

Table 1 Included journals, their impact factor (2021) and the number of articles sampled

Journal	Impact factor	No. of articles
The Modern Language Journal	7.500	198
Computer Assisted Language Learning	5.964	202
Journal of Second Language Writing	5.448	127
Language Learning	5.240	196
Language Teaching	4.769	139
Bilingualism: Language and Cognition	4.763	368
Studies in Second Language Acquisition	4.730	203
Language Learning & Technology	4.694	128
System	4.518	596
ReCALL	4.235	83
Applied Linguistics	4.155	215
Annual Review of Applied Linguistics	3.870	58
TESOL Quarterly	3.410	233
Language Teaching Research	3.401	194
International Journal of Bilingual Education and Bilingualism	3.165	380
Assessing Writing	3.164	144
Applied Linguistics Review	3.063	132
Foreign Language Annals	2.976	221
Second Language Research	2.889	130
Journal of English for Academic Purposes	2.889	266
ELT Journal	2.481	193
Language and Education	2.432	154
English for Specific Purposes	2.417	144
Language Testing	2.400	132
Language Policy	2.355	123
Language Culture and Curriculum	2.214	116
Corpus Linguistics and Linguistic Theory	2.143	82
Language Assessment Quarterly	2.143	130
International Review of Applied Linguistics in Language Teaching	1.971	91
Language Awareness	1.867	87
Applied Psycholinguistics	1.828	273
Cognitive Linguistics	1.796	114
Journal of Language Identity and Education	1.770	139
International Journal of Bilingualism	1.721	326
Language Acquisition	1.600	96
English Today	1.156	145
World Englishes	1.154	229
Canadian Modern Language Review	0.925	108
International Journal of Corpus Linguistics	0.919	93
Vigo International Journal of Applied Linguistics	0.917	30
Lingua	0.916	445
English Teaching-Practice and Critique	0.862	139
		7602

3.2 Data Processing and Analysis

The bibliographic records were processed in CiteSpace Version 5.8 R3 (Chen 2016) to address the three research questions regarding the most frequently discussed topics (RQ1), most highly cited publications (RQ2), and most highly cited authors (RQ3). For RQ1, two methods were adopted. First, we extracted topic terms (noun phrases of up to five words) from the titles, abstracts, and keywords of the surveyed articles to expand Lei and Liu's (2019) procedure that extracted topic terms from abstracts only. Through CiteSpace's text processing function, the procedure generated a list of 336 noun phrases with a minimum frequency of 30 (a cut-off set by Lei and Liu 2019). These noun phrases were then manually scrutinized for their meaningfulness as research topics. We eliminated the following three types of noun phrases: (1) general concepts and issues related to research but not specific to applied linguistics (e.g., *significant difference*, *previous research/study*, *growing body*); (2) noun phrases that are common in applied linguistics but are too general to be meaningful topics (e.g., *applied linguistics, pedagogical implications, first/second/foreign/language, target language, additional language, English, English learning*); (3) variations of noun phrases with higher frequencies (e.g., *L2 acquisition* [77 times] vs. *second language acquisition* [325 times]; *individual differences* [71 times] vs. *individual difference* [138 times]. Following the data cleaning, the remaining noun phrases were grouped into four domains of applied linguistics research (see de Bot 2015): psycholinguistic (e.g., *motivation*), sociolinguistic (e.g., *language ideologies*), educational (e.g., *language teachers*), and methodological/theoretical (e.g., *corpus linguistics*) to aid interpretation. Inevitably, the data cleaning and categorisation involved some subjective decisions, which were, however, thoroughly discussed between us. The remaining topic terms were then manually compared with those Lei and Liu (2019) provided to identify new research topics.

Second, we employed document co-citation analysis (DCA) to generate clusters of references as representatives of frequently discussed topics. This method complements the first one to address RQ1 by focusing on salient themes identified through a close examination of the content of the clusters. As over 198,000 unique references (documents) were co-cited by the surveyed articles, it was necessary to limit the number of cited references (called nodes) in a co-citation network for ease of computation and interpretation. After experimenting with different parameters, we adopted a CiteSpace configuration that selected the top 20% of the most cited publications per year from 2017 to 2021 (with a minimum of 6 co-citations received within 5 years after publication) because it produced the best network quality in terms of clarity and homogeneity. To assess the quality, we used modularity and silhouette scores (Chen 2016). The modularity (Q) score ($0 \sim 1$) indicates the overall quality of a network in terms of its clarity of decomposition into distinct clusters. The silhouette (S) score ($-1 \sim 1$) gauges the homogeneity of the members of a cluster. Weighted mean silhouette, derived from the composite clusters and accounting for their sizes, reveals the overall homogeneity of the network or clusters. Our DCA

network had a Q = 0.6712 and weighted mean S = 0.8937, indicating a well-structured network and high homogeneity of the clusters. To identify each cluster's theme(s), we examined their member publications, particularly key publications (i.e., highly cited ones or those experiencing a surge of citations as indicated in CiteSpace). We read the titles, abstracts, keywords, table of contents (for books), and main sections or chapters while noting the most salient themes. These themes were then compared across members of the cluster and against the labels automatically generated by CiteSpace. One of us then proposed a list of themes for discussion, whereby we resolved our occasional disagreements.

To answer RQ2, we generated via CiteSpace a list of the top 50 most cited publications from the reference lists of the surveyed articles. This method was similar to Lei and Liu's (2019) identification of the top 20 most-cited publications. We provided 50 instead of 20 of the most cited to offer a fuller picture of the highly cited publications.

In a similar vein, to address RQ3, we identified through CiteSpace the top 50 most cited authors in the surveyed articles who have accumulated at least 250 citations in our dataset. It is worth mentioning that manual checking was done to unify the same author's names if their names were spelt differently in the references. For instance, citations respectively attributed to "Halliday M", "Halliday MAK", "Halliday Michael AK", and "Halliday Michael Alexander Kirkwood" were manually summated under "Halliday M". We believe that such a procedure enhanced the reliability of our analysis.

4 Findings and Discussion

This section presents the findings and discussion regarding the aforementioned research questions: (1) the most frequently discussed topics, (2) the most highly cited publications, and (3) the most highly cited authors.

4.1 The Most Frequently Discussed Topics

4.1.1 Topic Term Analysis

Our topic extraction procedure identified a total of 259 frequently occurring topic terms in the sampled articles. All topics are assigned to one of four domains: psycholinguistic, sociolinguistic, educational, and methodological/theoretical.

In the psycholinguistic domain, topics such as *EFL learners*, *motivation*, and *writing tasks* identified by Lei and Liu (2019) remained frequent. However, some new topics were also among the most frequently occurring, including proficiency-related topics (e.g., *language proficiency, proficiency level, English proficiency*), L2-related (e.g., *L2 learning*, *L2 speakers, L2 writers, L2 motivation*),

cross-linguistic influences (e.g., *native language, native English speaker*), types of learner (e.g., *university students, graduate students, international students, advanced learners),* learning-related (e.g., *learning outcomes, learning process, learning experience*), and writing skills (e.g., *L2 writing, writing development, writing quality, writing instruction, written corrective feedback*). Consistent with the findings of previous reviews (Lei and Liu 2019; Zhang 2020), there appears to be less interest in some topics related to cognitive approaches (e.g., *cognitive control, cognitive load*), while a rising trend has been observed in socially-oriented approaches (e.g., *positive attitudes*). We acknowledge no clear-cut division between psycholinguistic and sociolinguistic topics (see also de Bot 2015).

A number of predominantly sociolinguistic topics, such as *bilingualism, multilingualism, bilingual education, language policy* and *language ideologies,* continued to attract research attention, as observed in the past two decades (Lei and Liu 2019). On the other hand, our list also included new topics such as *translanguaging, multilingual education, heritage speakers, bilingual advantages, Chinese English bilinguals, executive function, dominant language, home language*, *third language,* and *social justice.* We will zoom in on translanguaging later, as DCA identified it as a hot area.

As for the educational topics, we highlight three noteworthy topical areas not mentioned in Lei and Liu (2019). One concerns language teacher education as reflected in high-frequency topics such as *professional development, language teachers, pre-service teachers, language teacher education, teacher agency, teacher beliefs, teacher identity,* and *teacher training*. Another frequently discussed educational topic area concerns language testing as captured by *assessment, test scores, test takers,* and *writing assessment.* A third topical area concerns teaching methods such as *task-based language teaching, English-medium instruction, data-driven learning,* and *foreign language teaching.*

Finally, regarding methodological or theoretical interests, we observed frequently referenced theories/approaches such as systemic functional linguistics, multimodality, conversation analysis, usage-based approach and construction grammar, together with corpus linguistics, sociocultural theory, and genre analysis that continued to be frequently adopted. There also seemed to be new trends in using structural equation modeling, systematic review, and thematic analysis to conduct studies, together with continuing interest in methods such as eye tracking. Interestingly, we also noted some of the most frequently studied contexts, languages, or speakers, including Spanish, Hong Kong, Mandarin Chinese, French, Japanese and South Korea (ranked by frequency).

4.1.2 Document Co-citation Analysis

Our DCA generated a network ($Q = 0.6712$, weighted mean $S = 0.8937$) of 417 co-cited references with 1709 co-citation links. The network consisted of 26 clusters, 8 of which had at least 30 members and thus merited close examination. Table 2 presents these largest clusters, totaling 392 references (94% of the network),

Table 2 Major clusters of co-cited references ranked by size

Cluster	Size	Silhouette	Mean year	Salient theme
#0	79	0.934	2015	Multilingualism and Translanguaging
#1	55	0.818	2013	SLA and pedagogy
#2	48	0.921	2016	Psychological factors (individual differences)
#3	48	0.811	2015	Implicit and explicit (vocabulary) learning
#4	44	0.971	2015	Bilingualism and bilingual advantage
#5	43	0.920	2016	L2 writing and linguistic complexity
#6	41	0.836	2017	Research synthesis
#7	34	0.916	2015	Grammatical processing

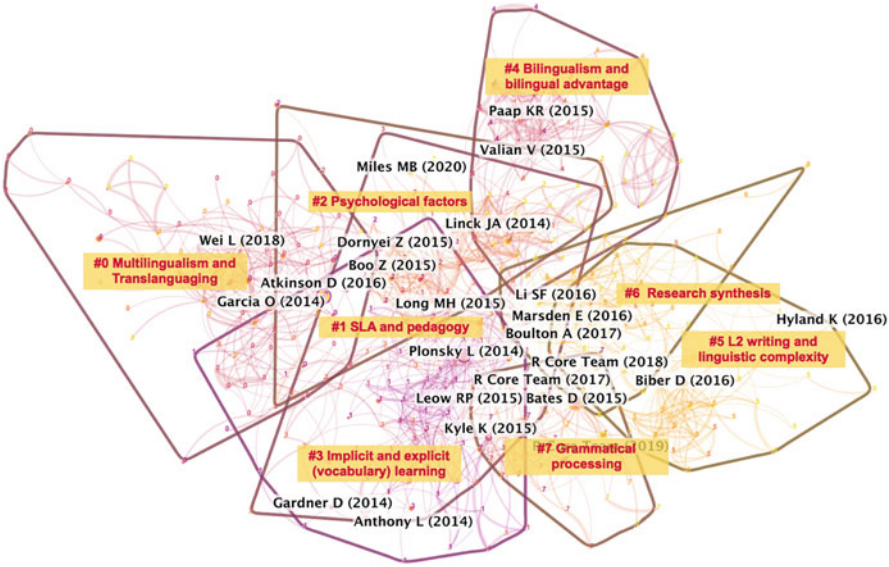

Fig. 1 DCA network of major clusters. Cluster labels derived based on a procedure discussed in the methodology section were manually added to the figure to facilitate interpretation. The key publications are represented by the first author (e.g., García O 2014 in Cluster #0 stands for García and Wei 2014)

and the network map in Fig. 1 illustrates the clusters and some of their key member publications. These clusters are discussed below in terms of their salient themes so as to provide another perspective, apart from the topic terms generated from the citing papers, on the most discussed topics in the discipline.

Cluster #0 Multilingualism and Translanguaging As key publications in this largest cluster (see Table 3) have shown, a most prominent trend in recent applied linguistic research is what is known as the multilingual turn (May 2014) or the translanguaging turn (García and Li 2014), which sees multilingualism and translanguaging practices as the linguistic norm of the twenty-first century.

Table 3 Some most highly cited publications in cluster #0

Freq.	Publication
105	García and Li (2014). *Translanguaing: Language, bilingualism and education*. Palgrave Macmillan.
96	Douglas Fir Group (2016). "A transdisciplinary framework for SLA in a multilingual world." *The Modern Language Journal.*
63	Li (2018). "Translanguaging as a practical theory of language." *Applied Linguistics.*
56	Otheguy, García, and Reid. (2015). "Clarifying translanguaging and deconstructing named languages." *Applied Linguistics Review.*
46	Patton (2014). *Qualitative research & evaluation methods* (4th ed). Sage.
45	Norton (2013). *Identity and language learning*. Multilingual Matters.
34	Darvin and Norton (2015). "Identity and a model of investment in applied linguistics." *Annual Review of Applied Linguistics.*
32	García et al. (2017). *The translanguaging classroom: Leveraging student bilingualism for learning.* Caslon, Philadelphia.
31	Canagarajah (2013). *Translingual practice: Global Englishes and cosmopolitan relations.* Routledge.
31	Flores and Rosa (2015). "Undoing appropriateness: Raciolinguistic ideologies and language diversity in education." *Harvard Educational Review.*
25	National Standards Collaborative Board. (2015). *World-readiness standards for learning languages* (4th ed.). ACTFL.
25	Cenoz, Genesee, and Gorter (2014). "Critical analysis of CLIL: Taking stock and looking forward." *Applied Linguistics.*
23	Kubota (2016). "The multi/plural turn, postcolonial theory, and neoliberal multiculturalism..." *Applied Linguistics.*
23	Cervantes-Soon et al. (2017). "Combating inequalities in two-way language immersion programs..." *Review of Research in Education.*
22	Canagarajah (2018). "Translingual practice as spatial repertoires. . ." *Applied Linguistics.*
21	Halliday and Matthiessen. (2014). *Halliday's introduction to functional grammar* (4th ed).Arnold.
20	Kane (2013). "Validating the interpretations and uses of test scores." *Journal of Educational Measurement.*
20	May (2014). *The multilingual turn: Implications for SLA, TESOL, and bilingual education.* Routledge.

Note. Frequency refers to the times a publication is co-cited together by others in the network. To save space, publication titles and other elements have been shortened. (The above note also applies to Tables 4, 5, 6, 7, 8, 9 and 10)

Embracing multilingual ideologies, socially-oriented applied linguistic scholars have increasingly challenged mainstream applied linguistics's monolingual ideologies and practices, which are defined by their linguistic-cognitive approaches. In his influential edited volume that helped shape the multilingual turn, May (2014) critiqued the "monolingual bias" in SLA and TESOL, including related notions such as "native speaker" and "mother tongue", and advocated for "an additive bilingual pedagogy for SLA and TESOL" (3). In response to the challenges posed by multilingualism and the changing landscape of learning and teaching additional languages in a multilingual world, some leading applied linguists known as the

Table 4 Some most highly cited publications in cluster #1

Freq.	Publication
125	Plonsky and Oswald (2014). "How big is 'big'? Interpreting effect sizes in L2 research." *Language Learning.*
62	Long (2015). *Second language acquisition and task-based language teaching.* Wiley-Blackwell.
37	Derwing and Munro (2015). *Pronunciation fundamentals: Evidence-based perspectives for L2 teaching and research*. John Benjamins.
37	Kyle and Crossley (2015). "Automatically assessing lexical sophistication. . ." *TESOL Quarterly.*
32	Lee, Jang, and Plonsky (2015). "The effectiveness of second language pronunciation instruction: A meta-analysis." *Applied Linguistics.*
27	Golonka et al. (2014). "Technologies for foreign language learning. . ." *Computer Assisted Language Learning.*
25	Jenkins (2013). *English as a lingua franca in the international university...* Routledge.
18	Ellis and Shintani (2013). *Exploring language pedagogy through second language acquisition research*. Routledge.
17	Crossley, Salsbury, and Mcnamara (2015). "Assessing lexical proficiency using analytic ratings..." *Applied Linguistics.*
17	Lantolf and Poehner (2014). *Sociocultural theory and the pedagogical imperative in L2 education...* Routledge.
16	Granena and Long (2013). "Age of onset, length of residence, language aptitude..." *Second Language Research.*
15	Lyster, Saito, and Sato (2013). "Oral corrective feedback in second language classrooms." *Language Teaching.*
15	Boersma and Weenink (2015). Praat: Doing phonetics by computer [Computer software].

Douglas Fir Group (2016) proposed a transdisciplinary framework for the SLA research community. Their framework included 10 research themes covering both neurobiological and cognitive micro levels and the sociocultural, educational, ideological and socioemotional aspects at meso and macro levels. Despite its visionary work, the Douglas Fir Group fell short of making multilingualism the central object of inquiry for SLA and social justice as its explicit disciplinary goal, both of which were believed to be indispensable for sustainable SLA research (Ortega 2019).

Related to multilingualism is the "translanguaging" (García and Li 2014) or "translingual" (Canagarajah 2013) approach to language learning and use, which represents a substantial portion of work included in the cluster. Translingual researchers adopted the *trans-* terms to show their ideological stance towards multilingual practices that is different from the traditional understandings of *bilingualism* or *multilingualism,* which postulate that languages are autonomous entities bound by their separate structures even after contact with other languages (just as perceived by monolingualism) and that speakers have separate competences for each language (Canagarajah 2013). Instead, translingualism posits that languages are "mobile resources" (Blommaert 2010, 49) as people shuttle between languages

Table 5 Some most highly cited publications in cluster #2

Freq.	Publication
69	Dörnyei and Ryan (2015). *The psychology of the language learner revisited*. Routledge.
60	Miles, Huberman, and Saldaña (2018). *Qualitative data analysis: A methods sourcebook* (4th ed). Sage.
42	Boo, Dörnyei, Z, and Ryan (2015). "L2 motivation research 2005–2014..." *System.*
40	Charmaz (2014). *Constructing grounded theory (2nd ed).* Sage.
28	Field (2013). *Discovering statistics using IBM SPSS statistics* (4th ed). Sage.
26	Oxford (2017). *Teaching and researching language learning strategies...*(2nd ed). Routledge.
25	Dewaele and MacIntyre (2014). "The two faces of Janus? Anxiety and enjoyment..." *Studies in Second Language Learning and teaching.*
25	Philp and Duchesne (2016). "Exploring engagement in tasks in the language classroom." *Annual Review of Applied Linguistics.*
23	Dewaele and MacIntyre (2016). "Foreign language enjoyment and foreign language classroom anxiety..." In *Positive psychology in SLA*. Multilingual Matters.
21	Dörnyei, Henry, and MacIntyre (Eds.). (2015). *Motivational dynamics in language learning*. Multilingual Matters.
21	Dörnyei and Chan (2013). "Motivation and vision: An analysis of future L2 self-images, sensory styles..." *Language Learning.*
20	Dörnyei and Kubanyiova (2014). *Motivating learners, motivating teachers: building vision in the language classroom.* Cambridge.
20	Dewaele et al. (2018) "Foreign language enjoyment and anxiety: The effect of teacher and learner variables." *Language Teaching Research.*
17	Kubanyiova and Feryok (2015). "Language teacher cognition in applied linguistics research. . ." *The Modern Language Journal.*
16	Saito et al. (2018). "Motivation, emotion, learning experience, and second language comprehensibility..." *Language Learning.*
16	MacIntyre, Gregersen, and Mercer (2016). *Positive psychology in SLA*. Multilingual Matters.

and mix them to create new grammar and meanings beyond their separate structures (Canagarajah 2013).

Translanguaging has been reframed from its original sense of using two languages for teaching to understanding how bilinguals and multilinguals "use their complex semiotic repertoire to act, to know, and to be" (García and Wei 2014, 137). In their seminal book on translanguaging, García and Wei (2014) viewed the "languaging" notion in trans-*languaging* as emphasizing speakers' agency in meaning-making. Li (2018) further elaborated that the notion focuses on the orchestration of the neural-bodily-worldly skills of *languaging*.

Many of the highly cited translanguaging studies in the cluster offered theoretical discussions to clarify issues or engaged in debates to challenge mainstream/traditional ideologies in applied linguistics. For instance, Li (2018) conceptualized translanguaging as a practical theory of language as a multilingual, multisemiotic, multisensory, and multimodal resource for meaning-making. He argued that translanguaging could contribute to debates over hypotheses concerning language

Table 6 Some most highly cited publications in cluster #3

Freq.	Publication
31	Gardner and Davies (2014). "A new academic vocabulary list." *Applied Linguistics.*
29	Anthony (2014). AntConc [Computer Software].
28	Leow (2015). *Explicit learning in the L2 classroom*. Routledge.
24	Linck and Cunnings (2015). "The utility and application of mixed-effects models in second language research." *Language Learning.*
23	Nation (2013). *Learning vocabulary in another language* (2nd ed). Cambridge.
16	Suzuki and DeKeyser. (2017). "The interface of explicit and implicit knowledge in a second language..." *Language Learning.*
14	Van Heuven et al. (2014). "SUBTLEX-UK: A new and improved word frequency database for British English." *Quarterly Journal of Experimental Psychology.*
13	Webb and Chang (2015). "Second language vocabulary learning through extensive reading with audio support..." *Language Teaching Research.*
13	Muñoz (2014). "Contrasting effects of starting age and input on the oral performance of foreign language learners." *Applied Linguistics.*

and thought and the modularity of mind. MacSwan (2017) objected to some translanguaging scholars' claim that discrete languages (and, by extension, multilingualism) do not exist. He countered that view by offering what he called "a multilingual perspective" on translanguaging, which accepts individual multilingualism as both psychologically real and universal. It can be expected that theoretical debates on translanguaging will continue in the future as it attracts both followers and opponents. It is worth mentioning that there are other approaches to multilingualism included in the cluster, such as CLIL (Cenoz et al. 2014), metrolingualism (Pennycook and Otsuji 2015), and English as a lingua franca (Jenkins 2015).

Cluster #1 SLA and Pedagogy A focus on SLA and pedagogy dominated the second-largest cluster (see Table 4). Two key publications dealt with disciplinary or methodological issues. As SLA marked its 40th anniversary, Ortega (2013) reviewed the field's achievements and suggested ways forward for delivering transdisciplinary relevance in the twenty-first century. Ortega argued that SLA needed to reframe itself as the study of late bi/multilingualism with a view to contributing to the wider field of language ontogeny. As the most cited publication in the cluster, Plonsky and Oswald (2014) proposed field-specific benchmarks for interpreting effect sizes in quantitative second language research based on a survey of 346 primary studies and 91 meta-analyses in L2 research. Their newly proposed benchmarks offered a useful tool for L2 researchers to more accurately gauge the practical significance of studies.

As regards specific topics in SLA, the following ones attracted much citation attention: vocabulary, pronunciation, speech fluency, corrective feedback, age and pedagogy. Vocabulary has been an active research area in the past few years, as seen in the range of topics examined: lexical coverage, lexical proficiency, automated tools and academic word lists. Lexical coverage refers to the percentage of known

Table 7 Some most highly cited publications in cluster #4

Freq.	Publication
40	Paap, Johnson, and Sawi (2015). "Bilingual advantages in executive functioning either do not exist or are restricted to. . ." *Cortex.*
40	Valian (2015). "Bilingualism and cognition." *Bilingualism: Language and Cognition.*
39	Montrul (2016). *The acquisition of heritage languages.* Cambridge.
39	Linck et al. (2014). "Working memory and second language comprehension and production: A meta-analysis." *Psychonomic Bulletin & Review.*
38	Bialystok (2017) "The bilingual adaptation: How minds accommodate experience." *Psychological Bulletin.*
24	Paap and Greenberg (2013). "There is no coherent evidence for a bilingual advantage in executive processing." *Cognitive Psychology.*
19	Green and Abutalebi (2013). "Language control in bilinguals: The adaptive control hypothesis." *Journal of Cognitive Psychology.*
16	De Bruin, Treccani, and Della Sala (2015) "Cognitive advantage in bilingualism: An example of publication bias?." *Psychological Science.*
16	Kupisch and Rothman (2018) "Terminology matters! Why the difference is not incompleteness..." *International Journal of Bilingualism.*
14	Kroll and Bialystok (2013). "Understanding the consequences of bilingualism for language processing and cognition." *Journal of Cognitive Psychology.*
14	Blom et al. (2014). "The benefits of being bilingual: Working memory in bilingual Turkish–Dutch children." *Journal of Experimental Child Psychology.*

words in a text. While it has been well established that 98% of lexical coverage is needed for successful reading comprehension, the threshold for listening comprehension remains open. Focusing on lexical coverage in both L1 and L2 listening comprehension, Van Zeeland and Schmitt (2013) argued for a lower vocabulary coverage target (95% or 2000 to 3000 word families) for adequate listening comprehension. This may be good news for L2 learners, but the researchers acknowledged that their findings should not be taken as the final answer due to the use of different discourse types and comprehension measures. Focusing on lexical proficiency, Crossley et al. (2015) examined the relations between holistic scores of lexical proficiency and analytic scores of vocabulary size, depth of vocabulary knowledge, and access to core lexical items. Based on human ratings of both spoken and written texts by L2 learners and native speakers, the authors found that collocation accuracy (representing depth of knowledge) was the most important predictor of lexical fluency. The finding added to our understanding of lexical proficiency and pointed to the importance of multi-word units in L2 learning and teaching. Taking a different approach from human ratings, computer tools were also developed to aid in the task of assessing lexical proficiency, such as Kyle and Crossley's (2015) Tool for the Automatic Analysis of LExical Sophistication (TAALES) and Coh-Metrix (McNamara et al. 2014). Finally, in the context of academic vocabulary, Ackermann and Chen's (2013) list of 2468 lexical collocations is clearly of value to language learners and EAP teachers.

L2 pronunciation has not traditionally received much attention in SLA. However, this seems to have been changing, as indicated by the highly cited publications in the

Table 8 Some most highly cited publications in cluster #5

Freq.	Publication
31	Hyland (2016). "Academic publishing and the myth of linguistic injustice." *Journal of Second Language Writing.*
27	Li (2016). "The construct validity of language aptitude: A meta-analysis." *Studies in Second Language Acquisition.*
25	Biber et al. (2016). "Predicting patterns of grammatical complexity across language exam task types and proficiency levels: *Applied Linguistics.*
25	Yoon and Polio (2017). "The linguistic development of students of English as a second language in two written genres." *TESOL Quarterly.*
19	Kyle and Crossley (2018) "Measuring syntactic complexity in L2 writing using fine-grained clausal and phrasal indices." *The Modern Language Journal.*
16	Lu (2017). "Automated measurement of syntactic complexity in corpus-based L2 writing research and implications for writing assessment." *Language Testing.*
15	Pallotti (2015). "A simple view of linguistic complexity." *Second Language Research.*

Table 9 Some most highly cited publications in cluster #6

Freq.	Publication
44	R Core Team. (2017). R: A language and environment for statistical computing.
35	Boulton and Cobb (2017). "Corpus use in language learning: A meta-analysis." *Language learning.*
34	Marsden, Mackey, and Plonsky (2015). The IRIS Repository: Advancing research practice and methodology. In A. Mackey & E. Marsden (Eds.), *Advancing methodology and practice...* Routledge.
33	Plonsky and Ghanbar (2018). "Multiple regression in L2 research: A methodological synthesis..." *The Modern Language Journal.*
29	Macaro et al. (2018). "A systematic review of English medium instruction in higher education." *Language Teaching.*
23	Thomson and Derwing (2015). "The effectiveness of L2 pronunciation instruction: A narrative review." *Applied Linguistics.*
22	Marsden et al. (2018). "Replication in second language research: Narrative and systematic reviews and recommendations for the field." *Language Learning.*
19	Saito and Plonsky (2019). "Effects of second language pronunciation teaching revisited..." *Language Learning.*
19	Macaro (2018). *English medium instruction.* Oxford.

cluster and the prominence of the speech analyzer - Praat (Boersma and Weenink 2015). The third most frequently cited book in the cluster, Derwing and Munro (2015), bridged a research-practice gap by focusing on pronunciation acquisition and teaching fundamentals. The book underscored intelligibility as the main goal for pronunciation learning/teaching, in line with a World Englishes perspective. Other noteworthy topics include the influence of L1, age and motivation on pronunciation learning, the importance of error gravity, and the social aspects of L2 accents.

L2 speech fluency was also the subject of some frequently cited studies (e.g., Bosker et al. 2013; De Jong et al. 2015). Bosker et al. (2013) investigated the contributions of different fluency measures (e.g., pauses, speed and repairs) to

Table 10 Some most highly cited publications in cluster #7

Freq.	Publication
191	Bates et al. (2015). "Fitting linear mixed-effects models using lme4." *Journal of Statistical Software.*
111	R Core Team. (2017). R: A language and environment for statistical computing.
69	Kuznetsova et al. (2017). "lmerTest package: tests in linear mixed effects models." *Journal of Statistical Software.*
61	Barr et al. (2013). "Random effects structure for confirmatory hypothesis testing. . ."*Journal of Memory and Language.*
42	DeKeyser (2015). Skill acquisition theory. In B. VanPatten & J. Williams (Eds.), *Theories in second language acquisition*. Routledge.
26	Matuschek et al. (2017). "Balancing Type I error and power in linear mixed models." *Journal of Memory and Language.*
24	Kaan (2014). "Predictive sentence processing in L2 and L1. . ." *Linguistic Approaches to Bilingualism.*
17	Lenth (2016). Least-squares means: the R package lsmeans. *Journal of Statistical Software.*
13	Hopp (2013). "Grammatical gender in adult L2 acquisition..." *Second Language Research.*
13	Cunnings (2017). "Parsing and working memory in bilingual sentence processing." *Bilingualism: Language and Cognition.*

perceived fluency. The results from four experiments with L2 Dutch speakers indicated that breakdown and speed fluency were most strongly related to perceived fluency. In another study on L2 fluency, De Jong et al. (2015) examined the extent to which one's speaking style or L1 fluency should be considered in measuring L2 fluency, with important implications for language testing.

Corrective feedback, or responses to erroneous learner utterances, is a complex and controversial topic in SLA. Reviewing research on oral corrective feedback in L2 classrooms, Lyster et al. (2013) concluded that while the provision of feedback was more effective than no feedback, variables such as linguistic targets and learners' age could mediate its effectiveness. The authors observed that "the most effective teachers are likely to be those who are willing and able to orchestrate [. . .] a wide range of CF types that fit the instructional context" (30).

Age is another widely acknowledged individual factor that can affect the rate of learning and ultimate attainment in L2, but there is much less consensus regarding the why behind age effects. Granena and Long (2013) suggested an earlier critical ("sensitive") period for L2 phonology (probably age 6–12) and later ones for lexis/collocations and morphology/syntax (ending in the mid-teens). They also found that language aptitude played a mitigating role in offsetting the negative age effects on learning lexis and collocations.

With regard to L2 pedagogy, Ellis and Shintani (2013) focused on the practical concerns of L2 teachers identified through popular teachers' guides and appraised the claims and recommended practices in light of current SLA research. The second most cited publication in the cluster, Long (2015), focused specifically on task-based language teaching (TBLT), discussing the psycholinguistic and philosophical

underpinnings of TBLT and outlining 10 methodological principles for the implementation of TBLT in various teaching contexts. To bridge the perceived divide between L2 pedagogy and SLA research, Lantolf and Poehner (2014) proposed an approach to language teaching that drew on Vygotsky's sociocultural theory and cognitive linguistics.

Cluster #2 Psychological Factors (Individual Differences) Research on psychological factors in language learning has typically focused on individual learner factors (e.g., motivation, emotion, strategies, intelligence, aptitude, personality) that may impinge on learning outcomes and, more recently, the social and cognitive processes of L2 learning (Ellis and Shintani 2013). Dörnyei and Ryan (2015), the most highly cited publication in the cluster (see Table 5), offered an updated view of the psychology of the language learner from Dörnyei's (2005) earlier bestselling monograph. The authors argue that the field needs to move away from the commonly adopted quantitative, psychometric approaches to qualitative, narrative methodologies. They proposed "narrative identity" as the overarching construct to capture individual differences because it was linked to "all parts of the learner's psychology" (203).

Motivation is perhaps the most studied psychological factor. Motivation research took off after Gardner and Lambert (1972) introduced the concepts of integrative and instrumental motivation in their pioneering work, while currently the most influential theory in the field is Dörnyei's (2005) L2 Motivational Self System (L2MSS) centering on L2 learners' perceptions of their desired future self-states. There has been a surge of motivation publications since the introduction of L2MSS, as observed by Boo et al. (2015) in a review of L2 motivation research during 2005–2014. The review revealed that alongside the traditional quantitative methodologies (e.g., questionnaires), there had been a substantial increase in qualitative and innovative methods (e.g., Q methodology). Similarly, the collection of studies by Dörnyei et al. (2015) represents recent efforts to reconceptualise motivation, from a complex dynamic systems perspective, as "motivational dynamics" characterized by complexity, variability and nonlinear change.

Vision, which involves images and senses, is another new concept recently developed to theorize motivation (Dörnyei and Chan 2013). The essential claim regarding vision is that "learners with a vivid and detailed ideal self-image that has a substantial L2 component are more likely to be motivated to take action in pursuing language studies than their peers who have not articulated a desired future goal-state for themselves" (Dörnyei and Chan 2013, 440). Dörnyei and Chan's (2013) empirical study confirmed that one's mental imagery capacity indeed influenced the development of ideal and ought-to L2 selves. Extending the vision lens of motivation from learning to teaching, Dörnyei and Kubanyiova (2014) discussed how language teachers could motivate learners through vision. The book provided evidence showing imagery skills are teachable and a practical framework for teachers to cultivate visionary students.

An under-researched but emerging area of research on individual differences focuses on emotions or affect, "shunned" (Dörnyei and Ryan 2015) as a poor

relation to rational thinking valued by the strong cognitivist disposition in SLA. Previous studies of emotions paid the most attention to how negative emotions such as anxiety (Horwitz et al. 1986) may hinder L2 learning and could be avoided. However, there has been a recent shift to positive emotions, as evident in a collection of theoretical, empirical and practical papers (MacIntyre et al. 2016) covering various topics, populations and contexts. This "positive" movement in applied linguistics was ushered in by the rise of positive psychology, which focuses on the positive aspects of human life (e.g., happiness, hope, resilience and grit) that help minimize the effects of negative emotions and promote personal resiliency (Dewaele and MacIntyre 2014; MacIntyre et al. 2019). For instance, Dewaele and MacIntyre's (2014) survey study found significantly more enjoyment than anxiety in the foreign language classroom. In another study, Dewaele and MacIntyre (2016) identified three dimensions of enjoyment: social (e.g., the satisfaction gained in a buzzing, positive classroom), private thoughts and feelings (e.g., internal pride and satisfaction gained from overcoming difficulties), and positive atmosphere created by both teachers and learners. Investigating the link between enjoyment/anxiety and learner and teacher variables, Dewaele et al. (2018) found that foreign language learners' anxiety was less related to teacher practices than enjoyment was.

Notably, there was a growing effort to incorporate emotions into motivation research. Such research (e.g., Teimouri 2017; Saito et al. 2018) reported that motivation and emotions were intertwined because motivated actions could evoke various emotions. The incorporation of learners' positive and negative emotions (e.g., anxiety, enjoyment and shame) into the L2 motivational self-system as mediating factors led Teimouri (2017) to argue that such theoretical re-mapping can provide a clearer picture of learners' emotions and motivational behaviors.

Apart from the above-mentioned individual differences, language learning strategies also received some attention, as shown in the frequent citations of Oxford's (2017) book. In addition, several methodology treatises, such as Charmaz's (2014) book on grounded theory and Miles et al.'s (2018) book on qualitative data analysis, were among the frequently cited in the cluster. This is consistent with the increasing emphasis on using qualitative methodologies to study individual differences discussed earlier in this section.

Cluster #3 Implicit and Explicit (Vocabulary) Learning The unifying theme of this cluster concerns implicit and explicit learning (see Table 6). Focusing on explicit learning, Leow (2015) advocated explicit learning in the L2 classroom from a student-centered perspective. The interface between implicit and explicit knowledge, or the relationship between the two types of knowledge, also attracted some attention. Lending further support to the importance of explicit learning, Suzuki and DeKeyser's (2017) study of L2 speakers of Japanese provided empirical evidence that automatized explicit knowledge, developed through explicit learning mechanisms, may affect the acquisition of implicit knowledge.

With respect to vocabulary learning, recent studies focused on the effect of incidental (implicit) vocabulary learning, where vocabulary knowledge is gained through extensive reading and listening (Webb and Chang 2015; Pellicer-Sánchez

2016). Adopting offline (vocabulary tests) and online (eye-tracking) measures, Pellicer-Sánchez (2016) examined L2 English learners' incidental acquisition of vocabulary knowledge *from* and *while* reading. Webb and Chang (2015) investigated incidental vocabulary learning through extensive reading with audio support and found high vocabulary gains in the experimental group. The study indicated that frequency of occurrence alone may not be sufficient for successful mastery of words and should be supplemented by other activities such as audio support, note-taking, dictionary consultation, and after-reading discussion.

Another way of facilitating vocabulary acquisition is intentional learning or explicit instruction. In the context of academic vocabulary, learners can take shortcuts by focusing on selected vocabulary important in academic contexts, according to Nation's (2013) comprehensive survey of L2 vocabulary learning and teaching. Such shortcuts include what are known as "core" academic vocabulary (Coxhead 2000) and discipline-specific vocabulary. Developing a new core academic vocabulary list was the aim of Gardner and Davies (2014), the most highly cited study in the cluster. Gardner and Davies (2014) aimed to address the perceived methodological issues with Coxhead's (2000) pioneering Academic Word List.

Methodologically, eye-tracking was utilized in recent studies of attention and incidental vocabulary acquisition (Godfroid et al. 2013, Pellicer-Sánchez 2016) to capture fine details of cognitive processes and measure target features/activities with greater accuracy. Also employed in research on vocabulary learning are some highly cited corpus tools such as AntConc (Anthony, 2014). A new word frequency database for British English constructed by Van Heuven et al. (2014) provides a valuable resource for psycholinguistic research. In terms of statistical analyses, to address the limitations of conventional tests such as ANOVA and *t*-test, Linck and Cunnings (2015) recommended using mixed effects models to allow for more data types and the relaxation of assumptions underlying the conventional tests. Clearly, the new technologies and tools have expanded the toolkit for research in applied linguistics.

Cluster #4 Bilingualism and Bilingual Advantage This highly homogeneous cluster (Silhouette value 0.971) was dominated by studies of the relation between bilingualism and cognition, particularly the cognitive benefits/advantages of bilingualism (see Table 7). While earlier studies (e.g., Oller and Eilers 2002) tended to view the linguistic performance of bilinguals negatively (e.g., a smaller vocabulary in comparison with monolingual peers), later studies shifted their attention to whether and how bilingualism enhances cognitive functions (e.g., Bialystok et al. 2008), particularly executive control – a set of general-purpose control processes that "manage, integrate, regulate, coordinate, or supervise other cognitive processes" (Valian 2015, 5). As bilinguals constantly engage in "language switching that involves monitoring the situation to select the appropriate language, activating the selected language, and inhibiting the other language", such extensive experience may lead to enhanced general cognitive control abilities not specific to language (Paap and Greenberg 2013, 232–233). However, the literature also documented inconsistent (from none to substantial) cognitive benefits of bilingualism (Valian

2015). The mixed findings led to some on-going heated debates between proponents (e.g., Ellen Bialystok and her colleagues) and opponents (e.g., Paap et al. 2015) of the bilingual advantage hypothesis, to which we turn below.

In two highly cited articles, Paap and colleagues (Paap and Greenberg 2013; Paap et al. 2015) challenged the evidential base of bilingual advantages in executive control. Paap and Greenberg's (2013) analysis of 15 executive processing indicators revealed inconsistent cross-task correlations, suggesting the lack of coherent evidence for domain-general executive control abilities. After identifying various statistical and methodological issues (e.g., misinterpretations, lack of control for confounding factors), Paap et al. (2015) claimed that bilingual advantages in executive control "either do not exist or are restricted to very specific and undetermined circumstances" (265). Similarly, de Bruin et al. (2015) presented evidence of a publication bias favoring studies reporting bilingual advantages over those reporting null or negative results. Proponents of the bilingual advantage hypothesis responded to these challenges. For example, Valian (2015) suggested that as executive function is a multi-faceted construct, multiple underlying mechanisms could be responsible for improving executive function. She speculated that the inconsistent benefits of bilingualism reported in the extant studies may be due to the fact that individuals differ in their amount and types of experience that may enhance executive function. In her view article, Bialystok (2017) attributed the inconsistent findings documented in the literature to methodological and conceptual issues. Additionally, studies of working memory have provided some evidence in support of the bilingual advantage hypothesis (e.g., Blom et al. 2014; Linck et al. 2014). Linck et al.'s (2014) meta-analysis supported the claim that working memory is an important part of the cognitive processes underlying bilingual language processing and L2 outcomes.

Bilingualism research focusing on cognitive advantages formed a largely closed cluster, with little interaction with the applied linguistics publications we have discussed. However, the frequent citations of these studies in our dataset indicate a trend of increasing cross-disciplinary dialogues between applied linguistics and other disciplines, such as cognitive science and psychology. Such interactions can be expected to continue to grow in the future so as to understand better the processes and mechanisms of bilingualism and L2 acquisition.

Cluster #5 L2 Writing and Linguistic Complexity L2 writing from the perspective of linguistic complexity was the primary focus of the studies in the cluster (see Table 8). In recent years, complexity has emerged as an important indicator of L2 writing performance, proficiency, development, and assessment (Bulté and Housen 2014). The cluster evidenced some recent attempts to conceptualize and operationalize the construct. For instance, Pallotti (2015) argued for "a simple view of linguistic complexity" by limiting the construct to its structural properties and operationalizing linguistic (or structural) complexity in terms of morphological complexity, syntactic complexity and lexical complexity.

In L2 writing research, syntactic complexity has received the most attention, typically understood as "the variety and degree of sophistication of the syntactic

structures deployed in written production" (Lu 2017, 494). Based on a review of three commonly used automated tools for syntactic complexity analysis (the Biber Tagger, Coh-Metric, and L2 Syntactic Complexity Analyser), Lu (2017) suggested that the syntactic complexity measures provided by the tools can help operationalize syntactic complexity measures in L2 writing assessment.

Some frequently cited studies in the cluster focused on the relationship of syntactic complexity to task types and proficiency levels (Biber et al. 2016), task complexity (Révész et al., 2017), genre differences (Yoon and Polio 2017), as well as the use of fine-grained clausal and phrasal complexity indices as predictors of writing quality (Kyle and Crossley 2018). Focusing on syntactic complexity features in standardized language tests (TOEFL iBT), Biber et al.'s (2016) study found that task differences were systematically correlated with complexity features. Révész et al. (2017) reported that content support led to more sophisticated vocabulary and overall syntactic complexity. Examining adult English-L2 learners' linguistic development and genre differences over a 4-month semester, Yoon and Polio (2017) found strong genre differences (higher complexity in argumentative than narrative essays) in phrasal complexity measures but limited developmental changes over time. Kyle and Crossley (2018) lent empirical support to other scholars' claims about the importance of phrasal elaboration as a measure of L2 writing quality.

Cluster #6 Research Synthesis This was the only cluster with a methodological theme focusing on research syntheses (See Table 9). Research syntheses, also known as systematic reviews, differ from traditional reviews in their use of a formal set of methods to extract data from primary studies and typically aggregate quantitative findings (Chong and Plonsky 2023). The majority of the publications in this cluster were meta-analyses or methodological syntheses, both of which have remained, until recently, marginal methodologies in applied linguistics. As the discipline matures, there have been growing efforts to consolidate its empirical base and increasing attention to "methodological infelicities and inconsistencies" (Plonsky and Derrick 2016, 538). Some of the most frequently examined research topics in the research syntheses include data-driven learning (DDL), English medium instruction (EMI), and pronunciation instruction. In a highly cited publication in the cluster, Boulton and Cobb (2017) made the first attempt to synthesize findings on the effectiveness of DDL approaches to L2 learning and use. In an attempt to ascertain the effects of EMI on both English and content learning in higher education, Macaro et al. (2018) systematic review of 83 studies provided a somewhat disappointing picture: the benefits of EMI to language learning were uncertain, as were its detrimental effects on content learning. As the authors argued, part of the issue lay in the methodological flaws of the extant research. Taking a meta-analytic approach to the efficacy of L2 pronunciation instruction, Saito and Plonsky (2019) confirmed the effectiveness of instruction in learners' monitored production of specific segmental or suprasegmental features, but improvement measured globally via subjective human judgments, especially on spontaneous tasks, remained unclear.

An emerging subtype of research synthesis in the discipline, a methodological synthesis focuses on describing and evaluating a methodological issue. Plonsky and

Ghanbar's (2018) synthesis evaluated 541 multiple regressions reported in 171 papers and identified inconsistences and lack of transparency in reporting practices, such as missing reliability estimates. Focusing on the internal validity of L2 studies, Plonsky and Derrick (2016) scrutinized 2244 reliability estimates reported in 537 research articles and found great variability in the three types of reliability measures (internal consistency, interrater reliability, and intrarater reliability). Replication is considered indispensable to many academic disciplines, including applied linguistics, due to its vital role in building up the knowledge base of a given discipline by testing the reliability and generalisability of original research. Despite the many calls for more replication research in applied linguistics, the number and quality of replication studies conducted have been astonishingly low: Marsden et al. (2018) found only 67 self-labeled replications in their narrative and systematic reviews on replication. Other issues identified included the lack of exact replication studies and the numerous and wide-ranging changes made to original studies.

For the sake of space constraints, we are only able to spotlight the above research/methodological syntheses. Our discussion has shown that applied linguistics as a discipline has become increasingly methodologically self-aware and that progress has been made in the area of research syntheses as a major means of diagnosing methodological issues in the discipline. We anticipate that in the years to come, meta-analyses and replication research will continue to increase as the discipline grows. Before moving on to the next and last cluster, we note that the most highly cited publication in this cluster is R Core Team's (2017) R software, a free computer package for statistical analysis and graphics. While it is not directly related to research synthesis, its high citation shows its rising popularity among applied linguists as a new powerful methodological tool to replace traditional toolkits, such as SPSS, due to its versatile functionalities.

Cluster #7 Grammatical Processing The dominant focus of publications in this cluster was on grammatical/sentence processing (See Table 10). This line of inquiry has increasingly gained attention among L2 acquisition and bilingualism researchers and aimed to account for L1 and L2 grammatical processing differences (Cunnings 2017). One influential theory proposed to account for L1/L2 differences in sentence processing is the Shallow Structure Hypothesis (SSH), which posits that L2 speakers tend to build 'shallow' syntactic representations during processing as they more likely experience problems and rely more on semantic, pragmatic and contextual information than L1 speakers (Clahsen and Felser 2006). In a recent review of the SSH literature, Clahsen and Felser (2018) clarified some common misunderstandings (e.g., "Shallow processing is specific to L2 speakers") and issues regarding the hypothesis. In light of new findings and theoretical developments, the authors suggested that the hypothesis needed to include assumptions about constraint weightings and the relative timing of different types of constraint or information sources in L1/L2 processing. Focusing on predictive processing (i.e., anticipating upcoming information during sentence processing), Kaan (2014) proposed that potential differences between L1 and L2 speakers' predicting behavior could be

attributed to factors such as frequency biases, competing information, and task-induced effects. Kaan's (2014) proposal drew support from empirical studies such as Hopp (2013), which examined grammatical gender in adult L2 acquisition.

From a working memory perspective, Cunnings (2017) argued that the ability to encode, store and retrieve information from memory was key to successful sentence comprehension and, hence, the primary source of L1/L2 differences in sentence processing. Finally, it is worth mentioning that DeKeyser's (2015) widely cited introductory chapter on skill acquisition theory in SLA highlighted the connections between SLA theories and cognitive science in that both have invoked the same mechanisms to explain L2 learning and a range of other skills. Several references related to the R software are also highly cited in the cluster (e.g., Barr et al. 2013, Bates et al. 2015), which will be discussed below.

4.2 The Most Cited Publications

We identified the top 50 most cited publications in the reference lists of the articles in our dataset. To track the latest developments in the discipline, these publications were compared with Lei and Liu's (2019) two lists[2] of the top 20 most cited publications from 2005 to 2016. Table 11 lists the top 20 most cited publications between 2017 and 2021, while the remaining publications (top 21 to 50) are presented separately in Table 11 for ease of reference.

Some latest trends emerge when the list in the table is compared with Lei and Liu's (2019) lists. First, several fairly recent methodological publications are among the top 20 most cited publications. These include the R program (R Core Team 2017, #1) and the associated Ime4 package (Bates et al. 2015, #2) and statistical solutions (Barr et al. 2013, #7), together with Plonsky and Oswald's (2014, #5) paper on interpreting effect sizes and Cohen's (1988) classic book *Statistical Power Analysis for the Behavioural Sciences.* This pattern corroborates our findings regarding the rising attention to methodological issues in the discipline (see the discussion on Cluster #6). Those relatively recent methodological publications (except Cohen 1988) have made it to the very top of the list, indicating the discipline's collective attention to quantitative tools and measures across areas or domains.

Second, the recent surge of interest in translanguaging is reflected by the citation-based ranking of García and Wei's (2014, #8) monograph. This is consistent with our earlier reported findings on the most frequently discussed topics identified through both topic terms and the clustering procedure. Third, the number of citations gathered by Dörnyei's (2009) chapter on the L2 motivational self-system shows the influence of the model and the popularity of motivation research in recent years.

[2] One list included the top 20 publications for each of four historical periods. The other list contained the top 20 publications published since 2005. Consequently, the top 20 lists in Lei and Liu (2019) actually covered many more than 20 publications.

Table 11 Top 20 most cited publications in applied linguistics papers (2017–2021)

Rank	Freq.	Publication Title	Author/Date
1	**399**	***R: A language and environment for statistical computing***	R Core Team (2017)
2	**351**	**"Mixed-effects models using lme4"**	Bates et al. (2015)
3	279	*Common European framework of reference for languages: Learning, teaching, assessment*	Council of Europe (2001)
4	277	*Mind in society: Development of higher psychological processes*	Vygotsky and Cole (1978)
5	**260**	**"How big is "big"? Interpreting effect sizes in L2 research"**	Plonsky and Oswald (2014)
6	225	*Longman grammar of spoken and written English*	Biber et al. (1999)
7	**223**	**"Random effects structure for confirmatory hypothesis testing: Keep it maximal"**	Barr et al. (2013)
8	**199**	***Translanguaing: Language, bilingualism and education***	García and Li (2014)
9	**191**	***Statistical power analysis for the behavioral sciences***	Cohen (1988)
10	160	"The role of consciousness in second language learning"	Schmidt (1990)
11	158	*Genre analysis: English in academic and research settings*	Swales (1990)
12	153	"Mixed-effects modeling with crossed random effects for subjects and items"	Baayen et al. (2008)
13	152	*The psychology of the language learner: Individual differences in second language acquisition.*	Dörnyei (2005)
14	145	*Bilingual education in the twenty-first century: A global perspective*	García (2009)
14	145	The role of the linguistic environment in second language acquisition. In W. Ritchie & T. Bhatia (Eds.), *handbook of second language acquisition*	Long (1996)
16	**131**	**The L2 motivational self system. In Z. Dörnyei and E. Ushioda (Eds.), *motivation, language identity and the L2 self***	Dörnyei (2009)
16	131	*Language and symbolic power*	Bourdieu (1991)
18	**130**	***Task-based language learning and teaching***	Ellis (2003)
19	128	*The sociolinguistics of globalization*	Blommaert (2010)
19	128	"A new academic word list"	Coxhead (2000)

Note. The boldfaced publications were not on Lei and Liu's (2019) lists

While motivation was not mentioned as a popular topic in Lei and Liu (2019), it was included in Zhang's (2020) bibliometric analysis of SLA research between 1997 and 2018. Finally, it is interesting to note that Ellis (2003) is on our top 20 list, indicating a relatively recent and sustained interest in task-based language teaching and learning. This citation-based result is consistent with our earlier finding that *task-based language teaching* was among the frequently discussed topic terms. Notably, de Bot (2015) is the only review that we have found mentioning this topic.

Table 12 also reveals a number of trends. First, several new methodological publications (i.e., not mentioned in Lei and Liu 2019) have again occupied the top cited spots, confirming the discipline's current methodological interest as we have discussed. The popularity of Braun and Clarke's (2006) journal article on thematic analysis corroborates our findings based on the topic terms and is consistent with the call for more qualitative methods in SLA research (see Cluster #2). Also confirming the findings of our co-citation analysis, there has been increasing interest in using R to analyze linguistic data, as shown by the high citations of Baayen's (2008) book, and in moving away from conventional statistics (e.g., ANOVA) to new statistical methods, as evident in the citation ranking of Jaeger's (2008) paper. The popularity of Norris and Ortega's (2009) paper on the measurement of linguistic complexity, accuracy and fluency reflects increasing attention to the operationalisations of these constructs.

Second, in terms of theoretical interest, the shift from linguistic-cognitive approaches to socially-oriented approaches in applied linguistics is evidenced in the high citations of Bakhtin's (1981) book *The Dialogic Imagination*. The multilingual turn in the discipline discussed earlier (Cluster #0) is reflected in the frequent citations of the Douglas Fir Group's (2016) position paper "A transdisciplinary framework for SLA in a multilingual world" and of instruments such as The Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian et al. 2007). Interest in translanguaging as a conceptual lens is evidenced by the many citations of Li (2011) (see Table 12). Similarly, recent attention to social psychological factors of learners, such as emotions and motivation, is reflected in the citation statistics for Horwitz et al. (1986) and Gardner (1985) (see Table 12). The continued interest in usage-based approaches to language learning can be seen in the popularity of N. Ellis (2002) and Langacker (1987).

Third, the growing interest in bilingual processing (see Cluster #7) is obvious in the citation-based rankings (see Table 12) of three publications on this topic: Green (1998), Kroll and Stewart (1994), and Green and Abutalebi (2013). Interestingly, the latter two papers are published in cognitive science journals (*Journal of Memory and Language* and *Journal of Cognitive Psychology*), indicating the transdisciplinary nature of this line of research.

Finally, we can gauge the increased interest in vocabulary learning and corpora in the popularity of Nation's (2006) paper "How large a vocabulary is needed for reading and listening?" and Davies's (2008) introduction "The Corpus of Contemporary American English", as we have discussed earlier in relation to the relevant clusters.

4.3 The Most Cited Authors

Table 13 presents the list of the top 50 most cited authors. The left half of the table shows the top 20 most cited authors for easy comparison with Lei and Liu's (2019) list of top 20, whereas the right half lists the remaining authors. Two interesting

Table 12 Top 21–50 most cited publications in applied linguistics papers (2017–2021)

Rank	Freq.	Publication title	Author/Date
21	127	*Research methods in applied linguistics*	Dörnyei (2007)
22	**126**	**"Towards an organic approach to investigating CAF in instructed SLA: The case of complexity"**	Norris and Ortega (2009)
23	124	*A cognitive approach to language learning*	Skehan (1998)
24	121	*Situated learning: Legitimate peripheral participation*	Lave and Wenger (1991)
25	**120**	***The dialogic imagination: Four essays***	Bakhtin (1981)
26	**119**	**"Using thematic analysis in psychology"**	Braun and Clarke (2006)
27	119	*Learning vocabulary in another language*	Nation (2001)
28	117	"Effectiveness of L2 instruction: A research synthesis and quantitative meta-analysis"	Norris and Ortega (2000)
29	**116**	**"The language experience and proficiency questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals"**	Marian et al. (2007)
29	116	*Corpus, concordance, collocation.*	Sinclair (1991)
31	113	"Mental control of the bilingual lexico-semantic system"	Green (1998)
32	**112**	***The corpus of contemporary American English: 520 million words, 1990–present***	Davies (2008)
33	111	Attention. In P. Robinson (Ed.), *Cognition and second language instruction*	Schmidt (2001)
34	**110**	***Foundations of cognitive grammar: Theoretical prerequisites.***	Langacker (1987)
34	110	"Translanguaging in the bilingual classroom: A pedagogy for learning and teaching?"	Creese and Blackledge (2010)
34	**110**	**"Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models."**	Jaeger (2008)
37	**108**	***Analyzing linguistic data.***	Baayen (2008)
37	**108**	***Social psychology and second language learning: The role of attitudes and motivation***	Gardner (1985)
39	**107**	**"Frequency effects in language processing: A review with implications for theories of implicit and explicit language acquisition"**	Ellis (2002)
40	**106**	***A comprehensive grammar of the English language***	Quirk et al. (1985)
41	104	*Speaking: From intention to articulation.*	Levelt (1989)
42	**102**	**"A transdisciplinary framework for SLA in a multilingual world"**	Douglas Fir Group (2016)
42	**102**	**"Foreign language classroom anxiety"**	Horwitz et al. (1986)
42	102	*The CHILDES project: Tools for analyzing talk.*	MacWhinney (2000)
45	101	*Constructions at work: The nature of generalization in language*	Goldberg (2006)

(continued)

Table 12 (continued)

Rank	Freq.	Publication title	Author/Date
46	98	*Constructing a language: A usage-based theory of language acquisition*	Tomasello (2003)
47	**96**	**"Moment analysis and translanguaging space: Discursive construction of identities by multilingual Chinese youth in Britain"**	Li (2011)
48	**94**	**"Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations"**	Kroll and Stewart (1994)
49	**93**	**"Language control in bilinguals: The adaptive control hypothesis"**	Green and Abutalebi (2013)
49	**93**	**"How large a vocabulary is needed for reading and listening?"**	Nation (2006)

Note. The boldfaced publications were not on Lei and Liu's (2019) lists

patterns that support our findings based on research topics can be observed. First, five new authors have made it to the top 20 list: Canagarajah, Garcia, Nation, R Core Team, and Bates. The scholarship of Canagarajah and Garcia converge on translanguaging (translingualism) and multilingualism, which is consistent with our earlier discussion on the multilingual turn in applied linguistics. The continued interest in vocabulary learning and use can account for the large number of citations attracted by Nation, a leading scholar in vocabulary studies, and other vocabulary scholars such as Laufer and Hulstijn (also among the top 20–50). The surging popularity of R and related statistic solutions such as lme4 is evident in the citation statistics for the R Core Team and Douglas Bates. Notably, with the exception of Nation, none of the above-mentioned authors appeared on any of the top 20/25/50 most cited author lists of previous reviews (de Bot 2015; Lei and Liu 2019; Zhang 2020). Our review has thus helped to recognize their contributions to the development of applied linguistics as a discipline while identifying new research trends.

Second, space allows us to highlight only a few new entrants on the top 20–50 list. Plonsky is influential for his work on SLA research methodology and research synthesis. Ortega, widely cited for her meta-analytic research (e.g., Norris and Ortega 2000), has also contributed to other topics, such as the debate on the multilingual turn in SLA discussed earlier. Both Plonsky and Ortega have thus helped bring attention to methodological issues in the discipline. Other noteworthy scholars, such as Li Wei, have been widely cited for his work on translanguaging (e.g., Li 2018). The recent surge of interest in a positive psychological approach to emotions in L2 learning has seen the work of Dewaele and MacIntyre widely cited. Lastly, the citations of Bachman's work provide further evidence in support of our earlier topic-based findings on the increased interest in language testing.

Table 13 Top 50 most highly cited authors

Rank	Freq.	Author		Rank	Freq.	Author
1	774	Ellis R		**21**	**408**	**Plonsky L**
2	633	Hyland K		22	396	DeKeyser R
3	627	Ellis N		**23**	**370**	**Ortega L**
4	609	Dornyei Z		**24**	**363**	**Pennycook A**
5	603	Halliday M		**25**	**362**	**Lantolf JP**
6	**588**	**Canagarajah S**		**26**	**360**	**Council of Europe**
7	587	Biber D		**27**	**358**	**Pavlenko A**
8	563	Long M		28	348	Laufer B
8	**563**	**Nation P**		**29**	**343**	**Cohen J**
10	**534**	**R Core Team**		**30**	**329**	**Larsen-Freeman D**
11	**495**	**García O**		**31**	**324**	**Chomsky N**
12	479	Swain M		**32**	**321**	**Kormos J**
13	468	Robinson P		**33**	**319**	**Kachru B**
14	464	Bialystok E		**34**	**310**	**Norris JM**
15	**456**	**Bates D**		**35**	**309**	**Kramsch C**
16	449	Vygotsky LS		**36**	**303**	**Bachman L**
17	429	Cummins J		**37**	**300**	**Schmitt N**
18	423	Swales JM		38	293	Skehan P
18	423	Blommaert J		**39**	**293**	**Grosjean F**
20	413	Gass S		**40**	**291**	**Li W**
				41	**290**	**Dewaele JM**
				42	**287**	**Gardner RC**
				43	**283**	**Baayen RH**
				44	**283**	**Montrul S**
				45	**282**	**Martin JR**
				46	281	Schmidt RW
				47	**276**	**MacIntyre PD**
				48	**274**	**Hulstijn JH**
				49	**272**	**MacWhinney B**
				50	**265**	**Norton B**

Note. The boldfaced publications were not on Lei and Liu's (2019) list

5 Conclusion

Our study used scientometric methods to track the recent trends and changes in applied linguistic research by examining over 7000 articles published in 42 journals from 2017 to 2021. Through analyses of topic words and the cited references, we identified the most frequently discussed topics as well as the most cited publications and authors. The triangulation of the trends identified from these three angles has strengthened the findings reported here. We do acknowledge the limitations of our methodology. First, we have focused only on 42 journals, though many more journals and books have published relevant research. Second, we have not examined

the content of the main data source (i.e., the 7602 publications in our dataset) but have focused only on the topic terms extracted from their titles, abstracts and keywords, as well as the cited references, as commonly done in scientometric studies. Third, the automatically-generated clusters occasionally contained some members that were 'noises' as they did not fit into the identified dominant themes, and as a result, these publications have not been discussed. There is thus subjectivity in interpreting the clusters as well as the topic terms. It is also impossible to review all relevant studies due to space constraints.

Given our focus on research trends in the discipline, we highlight several key findings here. First, the recent turn towards multilingualism, particularly translanguaging, is on the wing. While corroborating the earlier reviews (e.g., Lei and Liu 2019; Zhang 2020), our findings help to highlight their surging status in the discipline with further evidence. We anticipate that the trend will continue in the coming years. Second, there is growing interest in psychological factors (particularly emotions and motivation), instructional approaches (e.g., task-based language teaching, English medium instruction, data-driven learning) and teachers (e.g., professional development and teacher emotions), which were relatively understudied areas. Third, there has been continued or increasing attention to topics such as vocabulary learning, pronunciation instruction and speech fluency. Research on linguistic complexity and its role in L2 writing has also been very active. Fourth, cognitive approaches have also received much attention in research on bilingual advantages and grammatical processing. Fourth, a major contribution of our review lies in our findings about methodological issues. We have observed the surging adoption of new tools such as R (and statistical methods such as mixed-effects models) and eye-tracking to conduct quantitative research. Qualitative methods such as thematic analysis have also been increasingly used, perhaps partly due to the increasing popularity of new theories such as complexity theory. These aspects reflect the increasing interdisciplinarity of applied linguistics. Recently, more efforts have also been made to consolidate the disciplinary knowledge base through research syntheses, meta-analyses, methodological syntheses, and scientometric reviews. The heightened methodological awareness is a sign of the discipline's maturity and recognition of the need to update and expand its toolkit for new endeavors in uncharted territories. Finally, by examining the most cited publications and authors for the period of 2017–2021, we have been able to identify those who have contributed to the expansion of research topics as the new movers (e.g., Douglas Fir Group, Nation, Ortega), to theoretical developments as the new shakers (e.g., *Translanguaging: Language, Bilingualism and Education*, Canagarajah, García, Li Wei), to methodological improvements as the new innovators (e.g., "How big is "big'? Interpreting effect sizes in L2 research", R Core Team, Bates, Plonsky). With these findings, we hope our study has provided a most current overview of developments in the discipline. We also hope that our findings, including the lists of key topics, prominent publications and influential authors, can be useful to language learning researchers, teachers, and graduate students for research and teaching purposes.

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Topical Trends and Research Frontiers of Applied Linguistics Research Articles with Different Methodological Orientations: A Bibliometric-Synthetic Review

Mohammad Amini Farsani and Hamid R. Jamali

1 Introduction

1.1 Applied Linguistics in a Recent Decade

In his highly-cited book on thinking style, Robert J. Sternberg (1997) asserts that "what happens to us in life depends not just on *how well* we think, but also on *how* we think" (p. 18, emphasis in the original). As such, he put forth the notion of thinking styles[1] or a profile of thinking styles that subsequently affect individuals' actions and performances. In the recent decade, since the mid-2010s, applied linguists have been influenced by remarkably fresh thinking styles and insights both in substantive and methodological language-related problems. Content-wise, applied linguists have made impressive strides in the following L2 fronts:

> The rise of interdisciplinary thinking in opting for L2 topics (Amini Farsani and Babaii 2019), a possible amalgamation of theoretical underpinnings such as social and cognitive theories in Second Language Acquisition (Hulstijn et al. 2014; Riazi 2016), a reconceptualization of L2 motivation theories (Papi et al. 2019), the conceptualization of language-related problems as multi-layered (King and Mackey 2016), the rise of positive psychology in L2 studies (Dewaele 2019), learning-oriented assessment (Turner and Purpura 2016), research-informed pedagogy (Rose 2019; Sato et al. 2022), and teacher-research nexus (McKinley 2019).

[1] According to Sternberg (1997), "A style is a preferred way of thinking. It is not an ability, but rather how we use the abilities we have. We do not have a style, but rather a profile of styles" (p.19, *origin in emphasis*).

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Besides substantive issues, applied linguists have also made steady advances in methodological issues. These advances address research quality and methodological synthesis in different methodological orientations (Plonsky 2013; Riazi and Candlin 2014), statistical literacy and applying advanced statistical issues (Plonsky 2015), the rise of open science and replication research (Porte and McManus 2018), research (mis)practices and research ethics (Isbell et al. 2022), the recent emphasis given to publishing research-oriented articles notably the launching of the Research Methods in Applied Linguistics journal, and the rise of research methods and synthetic research as established strands in the British Association of Applied Linguistics (BALL) and the American Association of Applied Linguistics (AAAL).

All these advancements in contents and methodological movements herald blessed synchronicity between what AL researchers think and what they act. The way AL researchers think of the content and methodological issues and, at times, even their amalgamation of content and methodological issues (i.e., research-informed pedagogy or teaching-informed research) seems to AL researchers a serviceable model for solving L2 problems. As King and Mackey (2016, 223) put it, "applied linguistics is at its best when focused squarely on solving problems of language learning". Such instinct for prospective researchers is intensified and magnified in the recent era, given the cross-disciplinary and dynamic nature of AL and the rise of voluminous data. However, when there is too much to be known when there is a growing flow of information and big data, and when there is an "explosion in quantity and quality of applied linguistics research" (McKinley 2020, 1), it becomes difficult to locate research frontiers and the retrospective-prospective trends of L2 research in AL or related domains. In the absence of such synthetic information and data, AL researchers might tend to substitute intuitions for objectivity or evidence-based decisions.

Quite recently, to resolve the above concerns, applied linguists have adhered to the tenets of scientometrics to determine retrospective-prospective orientations to L2 issues in AL strands. We argue that scientometrics can serve as a leverage that can help AL researchers synchronize their thinking and research performance. Such synergy is timely 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, 2).

1.2 Scientometrics in AL Studies

Following research synthesis techniques, we adhered to an all-inclusive approach targeting AL-published articles in Scopus- and SSIC-indexed journals. As such, we systematically reviewed the articles published in AL from 2019, when the first serious publication of scientometrics in applied linguistics was recorded (Lei and Liu 2019a). Our search returned 24 studies, which are presented in Table 1. As Table 1 shows, since 2019, applied linguists have witnessed growing attention to applying applied bibliometrics and scientometrics to identify the research trends in

Table 1 Scientometrics studies published in AL research from 2019 to 2023

Studies	Author	Scope	Time	Data sources	Bibliometric indicators
Recent trends in applied linguistics (AL)	Lei and Liu (2019a)	Broad and inclusive: Including all AL journals	2005–2016	42 SSCI-indexed journals	Topics; citations; productive countries
The research trends of the *System*'s publications	Lei and Liu (2019b)	Narrow: One journal	1973–2017	*System*	Topics; citations
International advances in L2 motivation research	Fu and Zhang (2019)	Narrow: L2 motivation	2004–2018	SSCI-indexed journals	Topics; citations
Second language Acquisition (SLA)	Zhang (2020)	Narrow: SLA	1997–2018	16 SSCI-indexed *journals*	Topics; citations
Research trends of multilingualism	Lin and Lei (2020)	Narrow: Multilingualism	2000–2019	SSCI-indexed journals	Topics; citations; trend; publication venues
Publications in the Iranian Applied Linguistics Journals	Harandi et al. (2020)	Narrow: A specific context	2008–2019	Iranian AL journals	Publication trend; Topics; collaboration;
Methodological orientations, academic citations, and scientific collaboration in AL	Amini Farsani et al. (2021)	Broad and inclusive: Including all AL journals with different strands	2008–2018	18 SSCI-indexed journals	Citations and collaboration in quantitative, qualitative, mixed-methods, and systematic reviews
A bibliometric study of EAP research	Hyland and Jiang (2021a, b)	Narrow: EAP	1980–2020	40 SSCI-indexed journals	Topics; citations; productive countries/regions
Research trends in 'trans-' studies on writing	Sun and Lan (2021)	Narrow: 'Trans-' studies on writing	2011–2020	Peer-reviewed journals	Topics; citations;
Delivering relevance: The emergence of ESP as a discipline	Hyland and Jiang (2021a, b)	Narrow: ESP	1990–2019	SSCI-indexed journals	Topics; citations
AL research output of Saudi institutions in the web of science	Mohsen (2021)	Narrow: A specific context	2011–2020	SSCI-indexed journals	Topics; citations; collaboration; research productivity
Thirty years of TEFLIN journal	Syahid and Mukminatien (2021)	Narrow: A journal	1990–2019	Scopus-indexed journal	Topics; citations; research productivity; productive countries/regions; collaboration

(continued)

Table 1 (continued)

Studies	Author	Scope	Time	Data sources	Bibliometric indicators
Research trends in computer-assisted language learning	Lim and Aryadoust (2021)	Narrow: Computer-assisted language learning	1977–2020	11 Scopus-indexed journals	Topics; citations
Research trends in L2 written corrective feedback	Crosthwaite et al. (2022a)	Narrow: L2 written corrective feedback	1990–2020	158 Scopus-indexed journals, books and book chapters,	Topics; outlets; citations; geographical origins
L2 pronunciation	Demir and Kartal (2022)	Narrow: L2 pronunciation	1977–2020	15 SSCI-indexed journals	Topics; citations; publication sources
Research trends in task-based language teaching	Qin and Lei (2022)	Narrow: Task-based language teaching	1985–2020	All SSCI and A&HCI-indexed journals	TBLT related topics; citations; trends; venues; productive authors
Scopus-indexed corpus linguistics research in arts and humanities	Crosthwaite et al. (2022b)	Narrow: Corpus-based linguistics	2001–2021	429 Scopus-indexed journals	Topics; citations;
Motivation in second language acquisition	Wu (2022)	Narrow: L2 motivation	2000–2021	16 SSCI-indexed journals	Topics; citations; venues of publications;
The current landscape of English language teaching research in Southeast Asia	Ngoc and Barrot (2022)	Narrow: a geographical place	2015–2021	Scopus-indexed journals	Topics; research productivity; citations; collaboration

Interaction in written texts	Hyland and Jiang (2022)	Narrow: Interaction	1990–2020	SSCI-indexed journals	Topics; citations; collaboration
The teaching English as a second language electronic journal (TESL-EJ)	Pearson (2022)	Narrow: One journal	1994–2022	*TESL-EJ*	Topics; citations; collaboration: Research productivity
A bibliometric analysis of the *IRAL*	Zhong and Liu (2023)	Narrow: One journal	1963–2022	*International Review of Applied Linguistics in Language Teaching (IRAL)*	Topics; citations; collaboration: Research productivity
Research trends and development patterns in *language testing*	Dong et al. (2022)	Narrow: One journal	1984–2020	*Language testing*	Topics; citations; collaboration; number of publications; test types; prolific countries/regions
Using data mining, text mining, and bibliometric techniques to research trends and gaps in the field of language and linguistics	CheshmehSohrabi and Mashhadi (2022)	Narrow: One journal	1973–2020	*System*	Topics; citations: Publication trend

AL strands. This fresh look at the AL research trend has stimulated a series of studies under three brands. The first set of studies (n = 16, 67%) used the scientometrics approach for delineating the research trends in broad (i.e., all AL strands) and specific domains or sub-domains in applied linguistics. These studies have primarily targeted second language acquisition (SLA) and its related issues, such as L2 motivation, L2 written feedback, L2 pronunciation, interaction, and L2 writing. Other specific AL domains such as multilingualism, English for Academic Purposes (EAP), English for Specific Purposes (ESP), task-based language teaching, and corpus-based linguistics have also been addressed. Retrospectively, studies within this broad-and-narrow camp have singled out the most frequent topics and research fronts, the highly cited authors and references, and the type and amount of scientific collaboration. Prospectively, these studies, boosting synthetic mentality, have scientifically mapped the untouched fronts and topics, hot topics, scientific networking, and put forward evidence-based and added valued recommendations for the primary researchers. With a primarily journal-specific orientation, a second group of scientometrics-based studies (n = 6, 25%) mapped one SSCI-indexed or Scopus-indexed specific journal of AL (e.g., *System*, *Language Testing*, *TESEL-EJ*, *IRAL*, *TEFLIN*). The researchers have dealt with the most prevalent topics, the highly cited articles, authors, references, and patterns of authorships. They have prospectively offered objective, systematic, and evidence-based recommendations for journal consumers such as readers, reviewers, and authors.

The third group of scientometric studies (n = 3, 12.5%) focused on the level of participation of non-anglophone AL researchers (e.g., Saudi Arabia, Southeast Asia, and Iran) in shaping L2 knowledge by mapping their research quantity and quality. Retrospectively, the researchers have addressed issues such as the most prolific authors, research productivity, the most frequent outlets for publications, and scientific collaboration. Prospectively, such evidence-based outputs help L2 local policymakers and authorities to see a gestalt view of their status quo of sharing knowledge dissemination of AL in the international arena and, subsequently, make informed decisions to set prospective research agendas.

1.3 The Present Study

As Table 1 presents, the studies, representing a snapshot of the latest scientometrics-based reviews, sought to map three brands of scientometrics in terms of strands, journals, and contexts in AL literature, offering objective, dynamic, and systematic recommendations for AL researchers. A cross-comparison of the studies in terms of focus, topics, data sources, and scope highlighted the following patterns:

A great portion of the studies examined specific domains and sub-domains of applied linguistics. Almost all the studies used SSCI-indexed *journals* for mapping the research trends. The mapping of the most frequent topics and the most cited authors, references, and articles has been remarkable in all the studies. However, it seems that all of the studies represented the research paradigms as taken-for-granted

and didn't differentiate the potential of each paradigm in shaping and advancing L2 knowledge. As L2-related problems expand, applied linguists "are increasingly pushing methodological boundaries to gain a clearer picture and deeper insights into the process of second language learning" (King and Mackey 2016, 212).

Given the centrality of rhetoric in paradigmatic orientations (quantitative, qualitative, mixed-methods, and secondary research), on the one hand, and considering the specific function and nature of L2 domains and sub-domains in shaping paradigmatic knowledge, on the other hand, it is warranted to map the research trends and frontiers in light of methodological orientations (i.e., quantitative, qualitative, mixed methods research, and secondary research). As Johnson et al. (2007, 117) put it, presenting a co-existing portrayal of paradigmatic orientations "might be healthy because each approach has its strengths and weaknesses and times and places of need". Accordingly, following synthetic and bibliometric techniques, we take the initiative to align the most represented research topics and frontiers research with methodological orientations by investigating the following research questions:

RQ1: What are the most frequent topics and research frontiers quantitative AL researchers have used to investigate language-related issues?
RQ2: What are the most frequent topics and research frontiers qualitative AL researchers have used to investigate language-related issues?
RQ3: What are the most frequent topics and research frontiers mixed-methods AL researchers have used to investigate language-related issues?
RQ4: What are the most frequent topics and research frontiers AL secondary researchers have used to investigate language-related issues?

2 Method

2.1 Identifying the Data Sources

This study combined research synthesis techniques and a bibliometric approach to examine the most frequent and highly cited keywords in quantitative, qualitative, mixed-methods and secondary studies in the representative applied linguistics (AL) journals over a decade from 2009 to 2018. We adhered to the research synthesis approach in terms of study identification and retrieval, data set coding procedures, and data analysis (Plonsky 2013). We used a triple sampling structure proposed by Amini Farsani et al. (2021) based on (a) the list of top journals (see Lei and Liu 2019a), (b) selecting top-tier journals (see Alise and Teddlie 2010) and (c) expert judgments. Applying the multilayer sampling procedures (Alise and Teddlie 2010), we came up with the 18 leading 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.* Having applied exclusion and inclusion criteria, our search returned 3824 empirical articles.

2.2 Coding

We manually categorized the 3824 studies into quantitative, qualitative, mixed methods, and secondary studies in this phase. We used different strategies reported in the literature to designate the methodological orientations (see Alise and Teddlie 2010; Amini Farsani et al. 2021; Riazi et al. 2018). The quantitative and qualitative studies were designated based on data collection and analysis. A study was designated as mixed-methods research if it systematically integrated quantitative and qualitative phases. According to Alise and Teddlie (2010, 111), a high degree of integration is characterized by studies "having more than one of the categories of sampling, data collection, data type, and data analysis being a heterogeneous mixture of quantitative and qualitative methods". A secondary study is characterized as "a continuum of techniques and research procedures that have been developed by social scientists with the aim of reviewing past literature systematically" (Ortega 2015, 219).

2.3 Bibliographic and Data Analysis

Bibliographic information for all the articles was retrieved from the Scopus database. Articles' titles, abstracts, and keywords were subjected to keyword co-occurrence analysis to identify topical trends in AL studies using VOSviewer software (https://www.vosviewer.com/). The software was also used to create a visualization of the most frequent keywords. Following van Eck and Waltman (2020), we also reported the bibliometric indicators for extracting the most frequent keywords as the following:

1. *Occurrence:* the number of articles in which the keyword has appeared. A binary method was used for counting, i.e., the presence of a term in a textual unit (an article's title, abstract, and keyword) regardless of its frequency in the same textual unit was counted as one.
2. *Total link strength:* the total strength of the links of an item with other items, i.e., the strength of the co-occurrence links of a keyword with other keywords
3. *Average Citation:* The average number of citations received by the documents in which a keyword term occurs.
4. *Average normalized citation:* The average normalized number of citations received by the documents in which a keyword occurs. The normalization corrects for the fact that older documents have had more time to receive citations than more recent documents. Values greater than 1 mean the item received more citations than the average of other items published in the same year.

3 Results

To specify AL research frontiers, we aligned the identified clusters with those strands of applied linguistics disseminated by the British Association of Applied Linguistics (BAAL) and the American Association of Applied Linguistics (AAAL). Then, in order to be consistent in reporting, we present the findings (cluster analysis and the most frequent keywords) in the following order: (1) The clusters and keywords identified in AL quantitative studies, (2) The clusters and keywords identified in AL qualitative studies, (3) The clusters and keywords identified in AL Mixed-Methods studies, (4) The clusters and keywords identified in AL secondary research.

3.1 Keywords in the AL Quantitative Studies

We extracted all the keywords (n = 220), with the occurrence of five or more, presented in AL quantitative studies. Eleven clusters were further identified. Figure 1 illustrates the clusters with different colors and sizes of nodes representing the occurrence frequency. As presented in Table 2 and Fig. 1, the quantitative studies could be mapped to the strands of applied linguistics. As such, we identified two patterns for the identified clusters, which mostly addressed the AL strands and

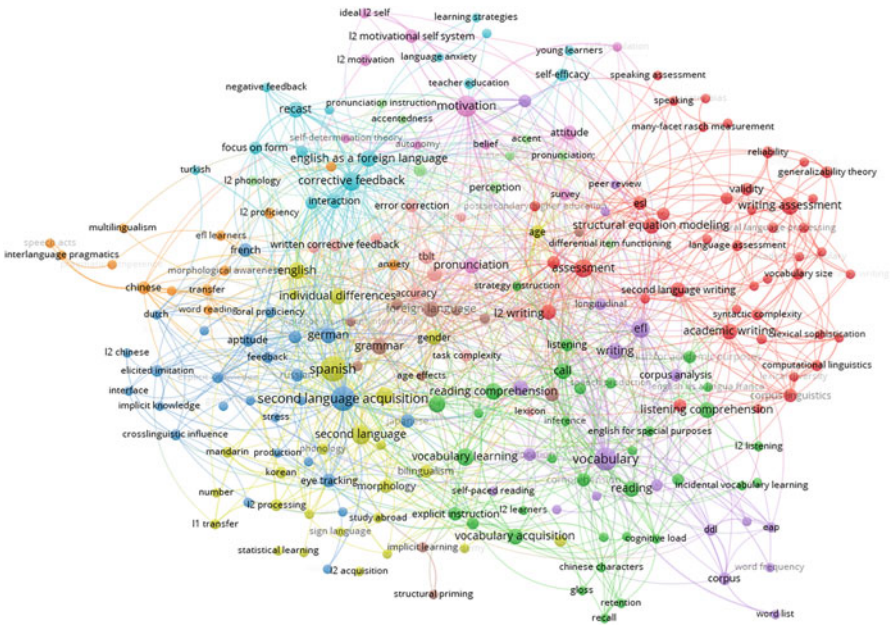

Fig. 1 Keyword map of the quantitative research approach

Table 2 The clusters identified in the quantitative studies and their alignment with AL strands

Clusters	AL strands/substrands	Instances of descriptors	No of keywords
Cluster 1	Testing, evaluation, and assessment	Assessment; construct validity; factor analysis; generalizability theory; integrated task; integrated writing; item response theory; language assessment; language testing; facet rash measurement; placement testing; rater bias; reliability; self-assessment; speaking assessment; structural equation modelling; test validity; testing; validity; writing assessment	45
Cluster 2	Language learning and teaching	Attention; cognitive load; comprehension; explicit instruction; extensive reading; foreign/second language learning; gloss; incidental learning; L2 learners; L2 listening; L2 reading; Mobile learning; reading strategy; retention; speech production; strategy instruction; video; vocabulary acquisition; vocabulary learning; working memory	34
Cluster 3	Bilingual, immersion, heritage, and language minority education	Cross-linguistic influence; Dutch; elicited imitation; French; German; Grammatical gender; heritage language learners; implicit knowledge; interface; Japanese; L2 Chinese; Mandarin Chinese; Oral proficiency; processing instruction; production; reactivity; Russian; Second language acquisition; stress; ultimate attainment; universal grammar	27
Cluster 4	L2 issues in educational linguistics	English; first language; frequency; gender; grammatical accuracy; Korean; L1 transfer; L2 acquisition; L2 processing; Mandarin; morphology; number; persuasion; phonology; polysemy; second language learning; sign language; Spanish; syntax	26
Cluster 5	Corpus-based linguistics	Collocation; computer-mediated communication; Concordancer; corpus; corpus analysis; DDL; EAP; formulaic sequence; lexical bundles; longitudinal; vocabulary; word frequency; word list	20
Cluster 6	(I)SLA	Classroom research; corrective feedback; English as a foreign language; focus-on-form; focus-formed instruction; interaction; language anxiety; learning strategies; negative feedback; recast; self-efficacy; synchronous computer-mediated; teacher education; Willingness to communicate	16

(continued)

Table 2 (continued)

Clusters	AL strands/substrands	Instances of descriptors	No of keywords
Cluster 7	Second language awareness	Chinese; EFL learners; interlanguage pragmatics; L2 proficiency; morphological awareness; multilingualism; phonological awareness; pragmatic competence; sociocultural theory; speech acts	13
Cluster 8	Individual differences	Age effects; aptitude-treatment interactions; foreign language anxiety; grammar; implicit learning; language aptitude; language learning strategies; structural priming	12
Cluster 9	Motivation and its correlates	Attitude; autonomy; belief; ideal L2 self; L2 motivation; L2 motivation self-system; motivation; pronunciation; self-determination theory: Self-regulation; survey	11
Cluster 10	Task-based language teaching	Accuracy; complexity; error correction; fluency; L2 writing; lexicon; SLA; task complexity; task repetition; TBLT	11
Cluster 11	L2 pronunciation	Accent; accentedness; comprehensibility; differential item functioning; intelligibility; L2 phonology; perception; pronunciation; pronunciation structure	9

substrands. The first pattern addresses the AL strands of *Language Testing and Assessment, Foreign Language Pedagogy, Multilingualism, Educational Linguistics, Corpus-based linguistics,* and *Instructed Second Language Acquisition,* respectively. In the second pattern, less emphasized than the first pattern, we also identified other substrands, such as Second Language Awareness, Individual Differences, Motivation, Task-based language teaching, and L2 pronunciation.

Besides reporting the prevalent strands and the quantitative research frontiers, we further extracted the most frequent and highly cited keywords in the quantitative studies (see Fig. 2). In Fig. 2, the size represents the occurrence frequency, and colors represent the average normalized citation of the keywords. It means the citation of the papers in which those keywords appeared. The yellow color depicts more citations. The colors indicate which topics attracted more citations. As Table 3 and Fig. 2 present, *Spanish, Second Language Acquisition, vocabulary, and motivation* are among the most frequent keywords that appeared in the AL quantitative studies. *Individual differences, corrective feedback,* and *motivation,* the issues attached to second language acquisition, received the highest citations.

Although *Testing, Assessment and Evaluation* were identified as the most prevalent strands in the quantitative studies, *SLA-based issues* were frequently reported and cited in the quantitative studies. Notably, besides English, 10 languages were presented in the quantitative dataset, including Spanish (72), German (20), French

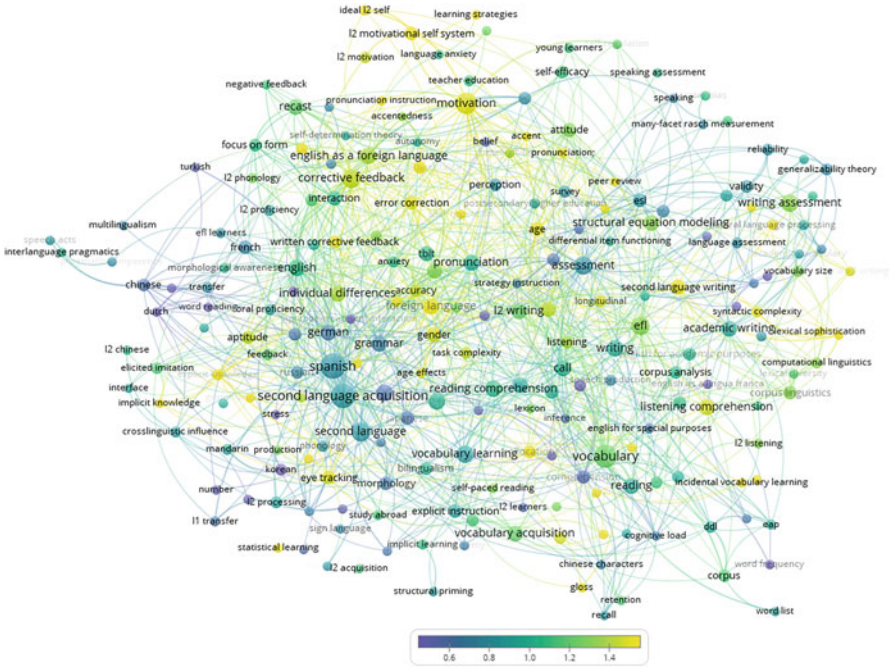

Fig. 2 Citation map of keywords in the quantitative research approach

Table 3 The 20 most frequent topics in quantitative studies

Rank	Keywords	Occurrence	Total link strength	Average citation	Average normalized citation
1	Spanish	72	129	15.6	0.78
2	Second language acquisition	66	112	16.6	0.82
3	Vocabulary	54	102	21.8	1.22
4	Motivation	47	77	30.3	1.46
5	Corrective feedback	33	74	30.5	1.40
6	Second language	32	55	14	0.82
7	EFL	30	56	22.1	1.28
8	Assessment	29	47	10.1	0.77
9	Writing assessment	27	31	24.7	1.28
10	Vocabulary learning	27	30	15	0.86
11	English	25	55	18.1	1.07
12	Working memory	24	44	20.6	0.98
13	English as a foreign language	24	36	28.5	1.34

(continued)

Table 3 (continued)

Rank	Keywords	Occurrence	Total link strength	Average citation	Average normalized citation
14	Second language learning	24	30	13.3	0.61
15	Reading comprehension	23	36	23.3	1.03
16	Writing	23	34	12.7	0.94
17	Recast	21	46	27.1	1.2
18	Grammar	21	43	13.3	0.72
19	Reading	21	42	19.5	0.93
20	Individual differences	21	37	30.6	1.35

(14), Japanese (14), Chinese (11), Russian (11), Korean (9), Mandarin (8), Dutch (6), Turkish (5), and Arabic (5).

3.2 *Keywords in the AL Qualitative Studies*

We extracted all the keywords (n = 98), with the occurrence of five or more, presented in AL qualitative studies. Eight clusters were further identified. As Table 4 and Fig. 3 present, we extracted two patterns: The first pattern, addressing the most frequent strands in the qualitative studies, consists of *Analysis of Discourse and Interaction, Teacher Education, beliefs, and identities, Writing and Literacy, Corpus Linguistics, and Language, culture, socialization, and pragmatic,* respectively. The second pattern, addressing the sub-strands of qualitative studies, comprises *Classroom Discourse*, *Writing Pedagogy*, and *SLA and writing,* respectively.

We further identified the qualitative studies' most frequent and highly cited keywords. As Table 5 and Fig. 4 present, *academic writing, teacher education*, and *motivation* are the most prevalent keywords that appeared in AL qualitative studies. *Teacher belief, academic writing, and genre analysis* received the highest citations (see Table 4). These findings reveal a roughly symmetrical representation of the keywords and their citations, signifying the centrality of teacher education and academic writing in the AL qualitative studies.

3.3 *Keywords in the AL Mixed-Methods Studies*

We extracted the keywords (n = 120), with the occurrence of five or more, presented in AL mixed-methods studies. Eight clusters were further identified. As presented in Table 6 and Fig. 5, mixed-methods researchers targeted *SLA-related issues*, *Language, culture, socialization and pragmatics* more frequently than other strands and

Table 4 The clusters identified in the qualitative studies and their alignment with AL strands

Clusters	AL strands/substrands	Instances of descriptors	No of keywords
Cluster 1	Analysis of discourse and interaction	Classroom interaction; collaborative learning; community of practice; discourse analysis; foreign language; immersion; interaction; learner autonomy; social networking	17
Cluster 2	Teacher education, beliefs, and identities	Activity theory; agency; language teacher education; pedagogical content knowledge; sociocultural theory; teacher belief; teacher cognition; teacher education; teacher identity	16
Cluster 3	Writing and literacy	Academic writing; engagement; English for academic purposes; genre; genre analysis; lexical bundles; move analysis; plagiarism; research article	13
Cluster 4	Corpus linguistics	All languages; assessment; case study; collocation; corpus-linguistics; EAP; email; feedback	13
Cluster 5	Language, culture, socialization and pragmatics	Blog; disciplinary discourse; EFL; English as a lingua franca; gesture; identity; multimodality; professional development; reading; reflection; teacher training	12
Cluster 6	Classroom discourse	Arabic; classroom discourse; conversation analysis; ESL; higher education; interactional competence	10
Cluster 7	Writing pedagogy	Bilingual; collaboration; collaborative writing; English language learning; longitudinal; second language writing; wiki; writing	8
Cluster 8	SLA and writing	Academic literacy; EFL writing; L2 writing; learner belief; motivation; willingness to communicate; writing assessment; written corrective feedback	8

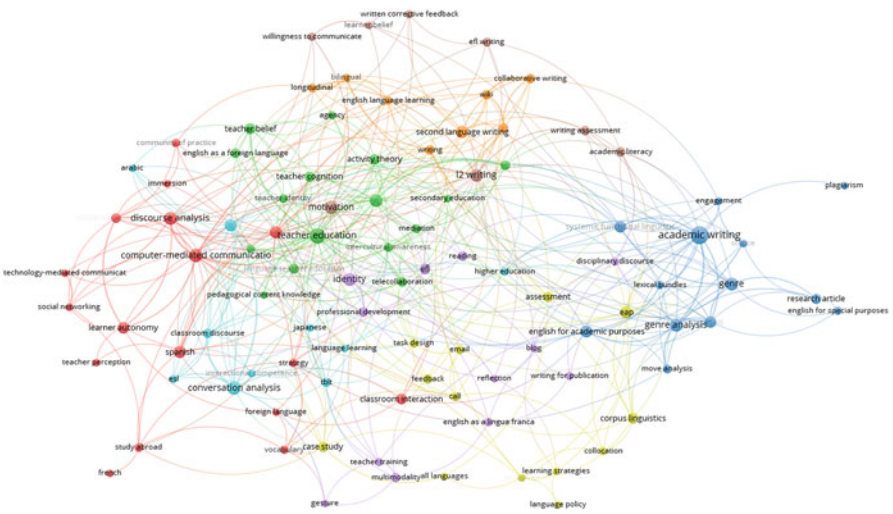

Fig. 3 Keyword map of the qualitative research approach

Table 5 The 20 most frequent topics in the qualitative studies

Rank	Keywords	Occurrence	Total link strength	Average citation	Average normalized citation
1	Academic writing	43	39	24.68	1.2
2	Teacher education	30	46	22.63	1.05
3	Motivation	21	19	19.71	1.14
4	Conversational analysis	20	25	22.1	1.17
5	Discourse analysis	19	24	14.05	0.84
6	Genre	19	21	17.84	1.01
7	Genre analysis	18	24	24.28	1.31
8	L2 writing	18	24	17.94	1.15
9	Sociocultural theory	18	31	13.83	0.99
10	Identity	18	19	23.11	1.17
11	Interaction	17	19	19.94	1.01
12	English for academic purposes	17	16	14.82	0.85
13	EAP	15	23	16.4	0.96
14	Second language acquisition	15	22	17.07	0.92
15	Second language writing	15	18	16.2	1.13
16	Spanish	15	12	11.67	0.57
17	Corpus	14	23	18	1.01
18	Learner autonomy	14	12	22	1.14
19	Systemic functional linguistics	13	13	9.54	0.57
20	Teacher belief	12	16	32.25	1.41

sub-strands. Unlike the monomethod orientations (i.e., quantitative or qualitative approach), the notable point here is the rise of mixed-methods research in Cluster 1 (SLA-based issues). This signifies the importance of the MMR approach in addressing SLA issues.

Besides reporting the prevalent strands, we further identified the most frequent and highly cited keywords in the MMR studies. As Table 7 and Fig. 5 present, *Academic writing* and *EAP* are among the most frequent keywords that appeared in AL MMR studies. As Fig. 6 illustrates, the articles with keywords of *blogs* and *academic writing* received more citations than the other keywords.

3.4 Keywords in the AL Secondary Studies

Besides identifying the most frequent keywords in primary studies with different methodological orientations, we also extracted the keywords presented in the AL

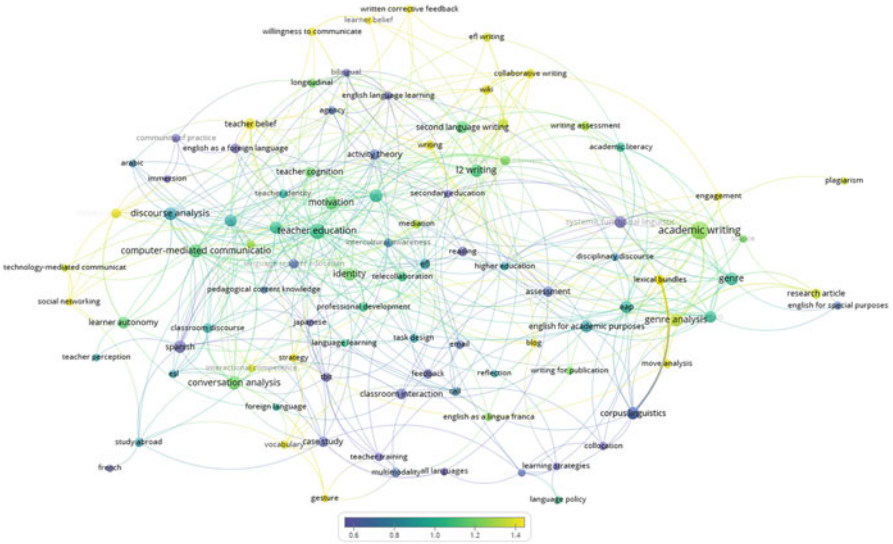

Fig. 4 Citation map of keywords in the qualitative research approach

Table 6 A profile of clusters identified in the MMR studies and their alignment with AL strands

Clusters	AL strands/substrands	Instances of descriptors	No of keywords
Cluster 1	Second language acquisition, language acquisition, and attrition	Anxiety; complexity; EFL learner; EFL writing; feedback; fluency; grammar; interaction; language learning strategies; learner autonomy; mixed-methods; mobile learning; pronunciation; reading; second language writing; SLA; vocabulary; willingness to communicate	25
Cluster 2	Language, culture, socialization and pragmatics	Arabic; China; content-based instruction; culture; email; English as a lingua franca; English for academic purposes; English language learning; gender; intercultural awareness; perception; sociocultural theory; Spanish	16
Cluster 3	Language and technology	Assessment; asynchronous CMC; attitude; blog; CALL; collaborative learning; computer assisted language learning; distance learning; social networking; telecollaboration	15
Cluster 4	Language learning and teaching	Academic literacy; blended learning; flipped classroom; foreign/second language teachers; history; international students; language proficiency; needs analysis; professional development; secondary education; student engagement; systemic functional linguistics; teacher education; writing development	14

(continued)

Table 6 (continued)

Clusters	AL strands/substrands	Instances of descriptors	No of keywords
Cluster 5	Other SLA-based issues	Business English; computer-mediated communication; corrective feedback; focus on form; focus-formed instruction; learning strategies; listening comprehension; noticing; oral proficiency; peer interaction; recast; second language acquisition; second language learning	13
Cluster 6	Individual differences	Chinese; English; evaluation; foreign language; French; higher education; ideal L2 self; language learning; motivation; second language; self-efficacy;	12
Cluster 7	Corpus-based/informed linguistics	Collocation; concordancers; corpus; corpus analysis; corpus linguistics; DDL; genre; identity; learner corpus; lexical bundles; revision; stance; (n = 12):	12
Cluster 8	Writing and its correlates in the academic context	Academic writing; discourse analysis; EAP; genre analysis; integrated task; L2 writing; metadiscourse; plagiarism; pragmatics; rating scale; research article; writing assessment	12

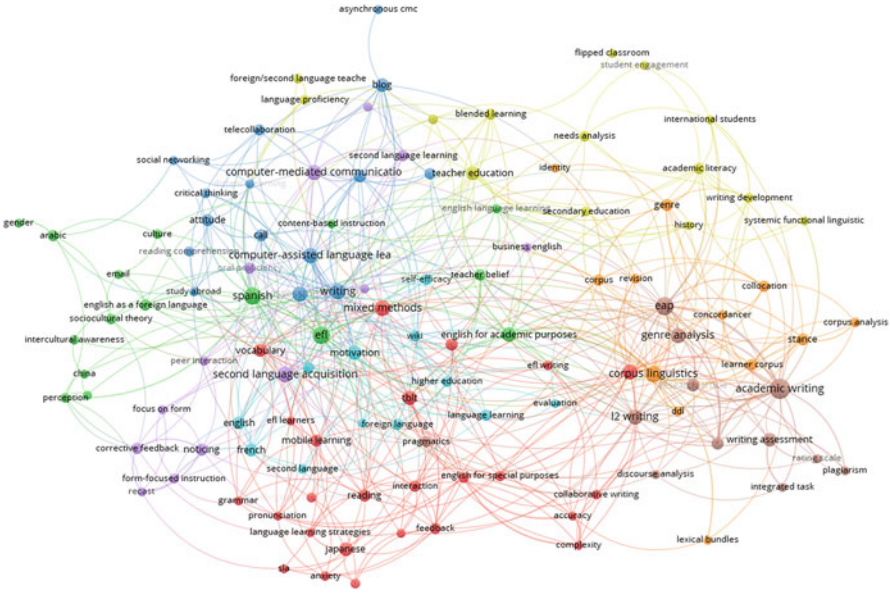

Fig. 5 Keyword map of the MMR research approach

Table 7 The 20 most frequent topics in the MMR studies

Rank	Keywords	Occurrence	Total link strength	Average citation	Average normalized citation
1	Academic writing	40	52	28.98	1.61
2	EAP	30	41	21.73	1.03
3	Spanish	27	31	11.81	0.67
4	EFL	25	32	26.08	1.24
5	Corpus linguistics	24	32	18.71	0.98
6	Writing	21	34	19.39	1.13
7	Mixed-methods	21	20	13.81	0.89
8	Second language acquisition	20	19	17.35	1.05
9	L2 writing	19	19	19	0.9
10	Second language writing	18	22	24.56	1.15
11	Computer-mediated communication	17	21	18.94	0.97
12	Assessment	17	19	13.47	0.66
13	Genre analysis	17	14	21	1.17
14	English for academic purposes	16	26	15.25	0.78
15	Motivation	15	22	20.53	0.98
16	TBLT	15	15	12.67	0.68
17	Writing assessment	14	11	23.5	1.07
18	Teacher education	13	17	14	0.83
19	Blog	13	15	43.15	1.49
20	Japanese	13	9	10.61	0.58

secondary studies. We extracted the keywords (n = 202), with the occurrence of five or more, presented in AL secondary studies. Twenty-three clusters were further identified with *L2 feedback* and *language and technology* as the most frequently represented strand and sub-strands, as presented in Table 8. Two methodological issues are also notable. The appearance of meta-analysis in different strands and the presentation of methodological research synthesis techniques (e.g., data, transparency, study quality, etc.) are in Table 9.

We further identified the secondary studies' most frequent and highly cited keywords. As Table 9 and Fig. 7 present, *meta-analysis*, *second language acquisition*, and *research methods* are among the most frequent keywords that appeared in AL secondary studies. This shows that meta-analysis for synthesizing SLA-based issues is trendy in AL secondary research. The articles with the keywords *recast*, *corrective feedback*, and *study quality* received the highest citations (see Fig. 8).

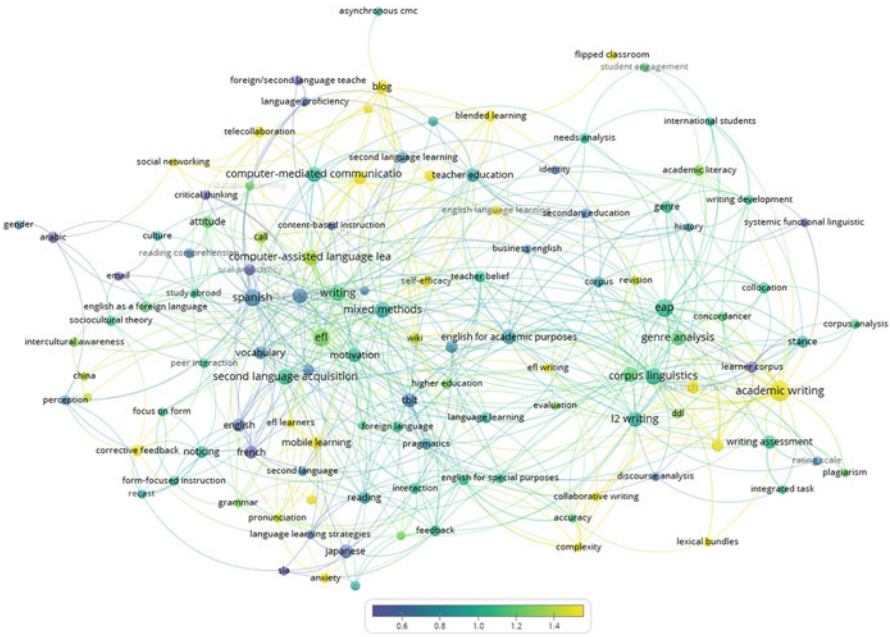

Fig. 6 Citation map of keywords in the MMR research approach

Table 8 The clusters identified in the secondary studies and their alignment with AL strands

Clusters	AL strands/ substrands	Instances of descriptors	No of keywords
Cluster 1	L2 feedback	Corrective feedback; domain definition; explicit feedback; implicit feedback; interaction; interactional feedback metalinguistic feedback; oral feedback types; recast	16
Cluster 2	Language and technology	Listening; MALL; mobile learning; mobile-assisted learning; research trends; technology-enhanced language learning	13
Cluster 3	Methodological-based issues	Instrumentation; methodology; needs analysis; psychometrics; publishing; reliability; replication; research design; validity	13
Cluster 4	Meta-analysis procedures	Data; effect size; graphics; interaction hypothesis; multiple regression; statistical reform; statistics; study quality	12
Cluster 5	Writing and academic literacies	Early literacy; EFL; emergent literacy; English learner; translingual; writing; writing development; writing instruction	11
Cluster 6	Language learning and teaching	Authentic environments; language learning strategies; motivation; second language learning; self-regulation;	10
Cluster 7	L2 gloss and vocabulary	Captioning; hypermedia; hypertext gloss; multimedia annotation; multimedia glosses; video; vocabulary acquisition;	10

(continued)

Table 8 (continued)

Clusters	AL strands/ substrands	Instances of descriptors	No of keywords
Cluster 8	Mixed issues	Construct-related validity; ecological linguistics; elicited imitation; intercultural communicative competence; multimodality; second and foreign language; task features; web tools and applications	9
Cluster 8	Mixed issues	Curriculum integration; EAP; educational technology; English for academic purposes; hawthorn effect; learning transfer; pedagogy; student development; writing from sources	9
Cluster 9	The use of corpus in L2 writing	Computer-assisted language learning; corpus-based language learning; DDL; L2 writing research; L2 writing research methods; L2 writing theories; research methods	9
Cluster 10	Meta-analysis and strategy-based instruction	Instructional effects; language learning strategies; quantitative meta-analysis; research interests; retrospective study; second language acquisition; strategy instruction	9
Cluster 11	Cognitive hypothesis and task complexity	Accuracy; cognition hypothesis; cognitive task complexity; fluency; lexical complexity; limited attentional capacity;	8
Cluster 12	Corpus-based/ informed pedagogy	Corpus consultation; corpus investigation; generalizability theory; L2 speaking; L2 writing; learner concordancing	8
Cluster 13	L2 awareness	Awareness; explicit knowledge; explicit learning; implicit knowledge; implicit learning; subjective measures	7
Cluster 14	Meta-analysis and technology	Classroom instruction; computer-assisted instruction; English language learning; meta-analysis; reading test; web-based instruction	7
Cluster 15	L2 writing	Collaborative learning; computer-mediated communication; Google docs; grammatical accuracy; second language writing; wiki; written corrective feedback	7
Cluster 16	Comprehension and production-based theory	Comprehension-based instruction; grammar instruction; processing instruction; production-based instruction; receptive and productive knowledge; skills acquisition theory	6
Cluster 17	Research synthesis	Grounded theory; peer feedback; reporting; synthesis; technology-supported; transparency	6
Cluster 18	Testing and assessment	Listening test; multiple choice; open-ended; reading test; test format; test method	6
Cluster 19	Language and technology	CALL; foreign language; mobile; technology-enhanced language; web	5
Cluster 20	Data sources for secondary research	Conference data; JALT national conference; review study; second language teaching; trends in language teaching	5
Cluster 21	L2 vocabulary	Incidental learning; meta-regression; mixed-effect modelling; word learning	5
Cluster 22	Reading comprehension	Componential view of reading; correlation; L2 reading comprehension; moderator	4
Cluster 23	Instructed SLA	Explicit/implicit instruction; explicit/implicit knowledge; instructed SLA	3

Table 9 The 20 most frequent topics in the secondary AL studies

Rank	Keywords	Occurrence	Total link strength	Average citation	Average normalized citation
1	Meta-analysis	24	100	63.87	0.99
2	Second language acquisition	9	41	37.44	0.87
3	Research methods	8	32	44.87	1.19
4	CALL	6	25	60.66	1.15
5	Systematic review	5	23	35.6	1.31
6	Corrective feedback	5	22	96.2	1.36
7	Computer-mediated communication	4	15	24.5	0.66
8	MALL	3	17	54	1.07
9	Vocabulary acquisition	3	15	56	0.98
10	Methodology	3	14	26	1.24
11	Qualitative research	3	13	67.66	1.84
12	Study quality	3	13	74.33	1.24
13	Effect size	3	12	49	0.80
14	Review	3	11	30.66	1.17
15	Synthesis	3	11	27.66	0.70
16	Second language writing	3	10	46	1.17
17	Writing	2	17	46.5	0.93
18	ESL	2	13	16.5	0.38
19	Recast	2	11	173.5	1.86
20	Reliability	2	10	33	0.88

4 Discussion

As Table 10 presents, our results exhibited several patterns of research fronts and key topics in different methodological orientations in AL. As for the quantitative studies, we found that AL researchers targeted different domains and sub-domains of AL, with *Language Testing and Assessment* as the most prevalent research front. This is roughly warranted given this strand's objective ontological nature, which addresses various issues such as testing and assessment of language abilities, assessment-informed data for evaluation purposes, test developments, washback studies, validation studies, and language assessment for specific purposes. To operationalize the variables and address research questions, AL researchers in this domain need sophisticated statistical strategies and techniques such as the Rash model, Structural Equation Modelling (SEM), and Discriminant Analysis (DA). Attached to quantitative orientation, these statistical techniques have played a central role in language testing and assessment (Read 2015).

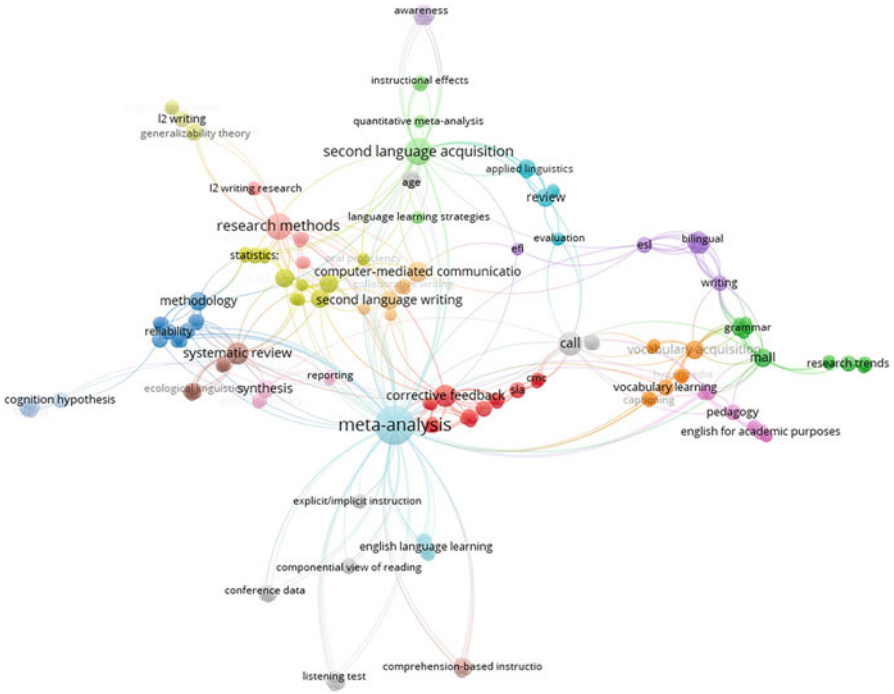

Fig. 7 Citation map of keywords in the secondary research approach

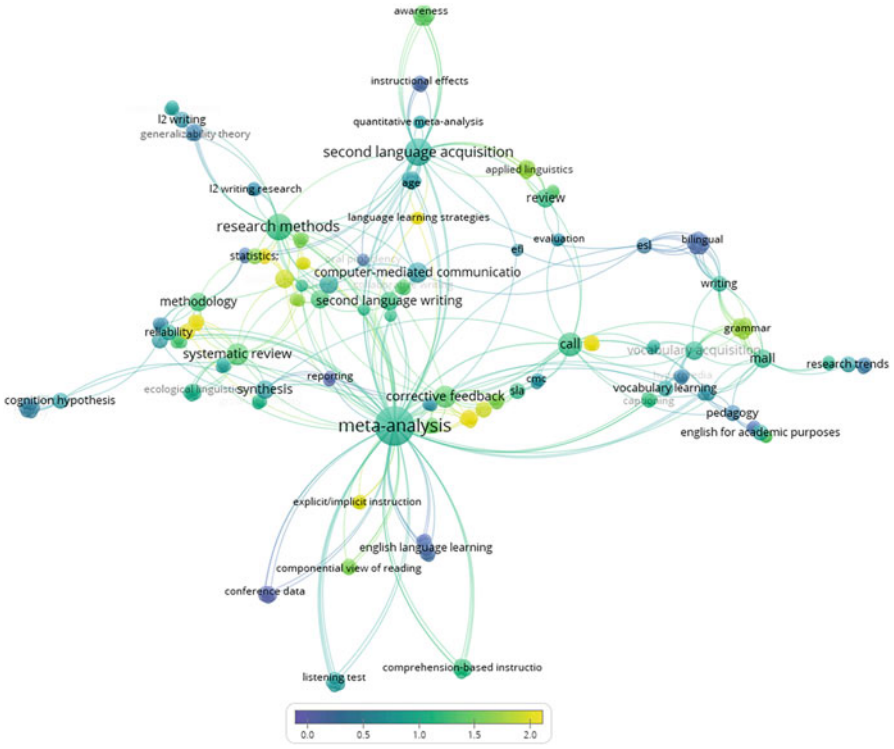

Fig. 8 Citation map of keywords in the secondary research approach

Table 10 Cross-comparison of AL research trends and topical issues in different methodological approach

Research Approach	The most notable Research frontiers	The most frequent keywords	Highly cited keywords
Quantitative	Language Testing and Assessment (45) Foreign Language Pedagogy (34)	Spanish (72) Second Language Acquisition (66) Vocabulary (54) Motivation (47)	Individual differences (30.6) Corrective feedback (30.5), motivation (30.3)
Qualitative	Analysis of Discourse and Interaction (17) Teacher education, beliefs, and identities (16)	Academic writing (43) Teacher education (30) Motivation (21)	Teacher belief (32.25) Academic writing (24.68) Genre analysis (24.28)
MMR	Second language acquisition, language acquisition, and attrition (25) Language, culture, socialization and pragmatics (16)	Academic writing (40) EAP (30)	Blogs (43.15) Academic writing (28.98)
Secondary	L2 feedback (16) Language & Technology (13)	Meta-analysis (24) Second Language Acquisition (9) Research methods (8)	Recast (173.5) Corrective feedback (96.2) Study quality (74.33)

Regarding the key topics, our results on the most frequent and highly cited keywords indicated the centrality of SLA-related issues (e.g., vocabulary, motivation, individual differences, and corrective feedback) in AL quantitative studies. Quantitative researchers seem to have targeted learner-oriented topics utilizing both experimental and survey designs. Such findings, similar to those reported by Zhang (2020) and Amini Farsani and Jamali (*in press*), highlight the significance quantitative applied linguists have ascribed to various subfields of (I)SLA, which has been then stimulated by cognitive, individual, or social theoretical underpinnings. The centrality of SLA-based issues in our primary quantitative studies is magnified, given the rise of SLA-based issues in secondary studies, notably meta-analysis. Our findings highlight such congruity between SLA-based issues in primary studies and secondary research with L2 corrective feedback and its related issues at the hub of meta-analysis, whose mechanism is highly contingent on the maturity of language-related problems (Plonsky 2017).

As for qualitative studies, the results revealed the prevalent occurrence of two major research fronts: *Analysis of Discourse and Interaction* and *Teacher Education, beliefs, and identities*. Analysis of discourse and interaction is mainly concerned with computer- and other forms of technology-mediated communication and face-to-face interaction in L2 classrooms. These interactions mostly happen in natural settings such as classrooms and employ various qualitative designs (e.g.,

ethnography, narrative analysis, discursive psychological research, critical discourse analysis, etc.) to trace and explore the natural behavior of participants. As such, the ontological nature of this strand calls for the use of a qualitative research approach.

The occurrence of teacher education and its related issues is also notable in qualitative studies. Unlike quantitative research with a high emphasis on L2 learners and learning, it seems that the qualitative researchers have concentrated on teaching and teacher-related issues, notably their beliefs and identities. This finding aligns with Borg's (2015) assertions that teachers' beliefs have immensely caught L2 researchers' attention from the 2000s onwards. The motive behind exploring L2 teachers' beliefs is that "they provide insight into the psychological context for teaching and teacher learning which can inform the design of initiatives which encourage teachers to learn, change, or behave in particular ways" (Borg 2015, 473). As for research designs, as Borg (2015) reported, the quantitative research approach might not provide any deeper consideration of its value; alternatively, L2 researchers mostly used qualitative instruments such as oral accounts, observation, written accounts, and visual methods to capture in-depth inference drawn from L2 classrooms.

The results further reveal the centrality of L2 writing in qualitative studies. Riazi et al. (2018) reported that qualitative research articles exceeded quantitative ones in the *Journal of Second Language Writing*. This is warranted given that L2 writing studies tend to "favor data gathered in naturalistic rather than controlled conditions" and "that 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" (Hyland 2016, 121).

As for MMR studies, the results reveal the rise of (Instructed) Second Language Acquisition (ISLA) in AL studies. The overall results reveal that ISLA has been examined from the quantitative, mixed-methods, and meta-analytic approaches. Such diverse perspectives on examining SLA-related issues can be interpreted in two ways. First, different methodological orientations bring about fresh inferences from a one-sided perspective to multiple perspectives, as practiced in mixed-methods research studies and meta-analyses. Here, when AL researchers examined SLA-based issues from the MMR lens, it seems that they consider its nature from different layers. The most concrete indicators of such views are embedded in Hulstijn et al.'s (2014) projections, which merge SLA theories' social and cognitive perspectives. Such amalgamation, as Riazi (2016) argued, calls for the employment of mixed-methods research to cater to different layers of SLA-based issues. MMR can address the challenges of ISLA research in different aspects, including L2 pedagogical practices and the complexity of teaching. According to Sato (2022, 82), "no single study can answer a pedagogical question that always involves multiple factors influencing the impact of teaching on student learning". Topic-wise, L2 academic writing and its related issues (e.g., EAP) have frequently occurred in MMR studies. Such a finding might be attributed to the rise of complex layers and the multidimensional nature of academic writing. This multidimensional nature of L2 writing needs multiple sources of data and MMR designs, which subsequently boost the plausibility of the interpretation of results (Hyland 2016).

Finally, concerning the secondary studies, our findings reveal that meta-analysis was frequently used to synthesize SLA-based issues. This is in line with Cooper's (2016) assertion that, among secondary studies, meta-analysis is the most pervasive review for synthesizing primary studies. Interestingly, we found that significance is ascribed to research quality through methodological synthesis. This finding shows that researchers consider both content/substantive and methodological issues in almost a symmetrical mode in AL. Contentwise, they have used meta-analytic studies for synthesizing language-related problems. Methodological-wise, they emphasized research quality. The latter provides empirical evidence for theorizing methodological research issues. According to McKinley's (2020, 1) assertion, researchers are living in "a golden age of applied linguistics research" in which they have an impressive tendency to ameliorate the field by improving research quality and rigor and enhancing research transparency through methodological research synthesis.

5 Implications for the Field of Scientometrics

The study has several implications. Firstly, it demonstrates the importance and potential of using scientometric techniques to identify research frontiers and key topics within different research approaches. This provides researchers with an overall understanding of the research trends in their field, enabling them to identify gaps in the literature or research orientations. Secondly, the study highlights the significance of different methodological orientations in applied linguistics research and how they complement each other by tackling different research problems. Specifically, the study showed that certain types of studies primarily address certain topics (e.g., quantitative studies mainly target SLA-related issues). This information can assist researchers in selecting appropriate methodologies to address specific research questions and in determining which statistical techniques are most suitable for analyzing their data. However, it is unclear why certain methods are more popular for certain topics. It could be due to the suitability of certain research approaches for specific research questions or to research traditions in academic departments and research groups that influence the choice of research methods. Finally, the study suggests an opportunity to use methods other than those previously used for each research topic, hoping to yield discoveries and understanding.

6 Conclusion

We bibliometrized the key lines of research and topical issues in four applied linguistics research paradigms in the recent decade. Our findings and our recent review of the AL scientometrics studies presented in the introduction highlight scientometrics' popularity in AL. The notable pieces of evidence showing the

increasing use of scientometrics in applied linguistics are the publication of the 2023 special issue on AL scientometrics in the *Journal of Studies in Second Language Learning and Teaching* (edited by Luke Plonsky) and the 2023 co-edited handbook on scientometrics in AL (edited by Rajab Esfandiari and Hossein Meihami). All these records herald the rise of a scientometric era in the third decade of 21st AL research. More and more AL researchers can portray a retrospective-prospective scientific mapping of research trends in AL and related strands. One realization of such instinct occurs when researchers or MA/PhD students want to select a language-related topic; they may consult with these grand blueprints and locate uncharted territory and gaps. Research-wise, in this study, we found out that some L2 topics embedded in AL domains can be examined from different perspectives. Without a scientometric approach, one might not be able to depict such informative and objective presentations of AL researchers' practices and their research tendencies.

Pedagogically speaking, such scientometric perspectives, along with the research synthesis family (notably meta-analysis and methodological research synthesis), can shape AL's research mentality to choose and conduct primary studies in light of a bird's view perspective. This stated we believe that those teaching research methodologies can add modules of 'scientometrics' and 'research synthesis' in their research methods syllabi to familiarize postgraduate students with its tenets and subsequently boost synthetic thinking. If we accept the growing popularity of scientometrics in AL, the next step would be examining the less touched domains and sub-domains of AL to depict an empirical map of the research trends and lines of research. Having mapped the AL domains and sub-domains, we then need to examine the quality and rigor of scientometrics and bibliometrics-based studies using meta-scientometrics. Likewise, as the results highlighted, scientometrics can help non-anglophone countries map their research trends internationally. Such lines of research await prospective researchers.

As a word of caution, we should point out that the study has some limitations. The data was limited to articles from 18 top-tier journals, and therefore, it may not fully represent the depth and breadth of the field of applied linguistics, including its diversity in terms of topics, researchers, and approaches. Moreover, we have relied on the Scopus database for the data, and although Scopus is a large database, it is not globally comprehensive. For instance, it might not capture all the citations to articles. Given these limitations, we can say that while the results are certainly indicative of the field, they are not conclusive.

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Research Topics in Applied Linguistics as Keywords from Authors and Keywords from Abstracts: A Bibliometric Study

William S. Pearson

1 Introduction

As applied linguists are tasked with searching for and retrieving relevant information from a rapidly expanding body of literature (Babaii and Taase 2013; Gillespie 2020; Hyland and Jiang 2021; Lei and Liu 2018; Zhang 2020), the need to efficiently grasp the essence of what research is about is imperative. Broadly, the overarching subject or issue of a research study is known as the research topic (Liu 2017). Frequently, a topic is stated as a single noun or multi-word expression (Powner 2017), for example, *metalanguage*, *phrasal verbs*, *second language writing*, and almost certainly addresses the question, 'what is this paper about?'. Typically, topics constitute the starting point of a research project, where novice and expert scholars iteratively explore, define, and refine their ideas (Liu 2017). Topics are included in a number of high-stakes academic decision-making scenarios, notably, student applications to undertake postgraduate research and for academics to obtain external funding. By featuring in academics' biographies (mainly at the end of research articles, on social networking services, and in curriculum vitae), topics help communicate the focal area(s) of individuals' research activities to both experts and a lay audience (Tripathi et al. 2018), facilitating the creation of research networks among like-minded scholars. Additionally, an outline of relevant research topics is frequently found in the 'aims and scope' section of academic journals, as is evident in the following extract from *System* (author's emphasis):

> This international journal is devoted to the applications of *educational technology* and *applied linguistics* to problems of *foreign language teaching* and *learning*. Attention is paid to the *learning* and *teaching* of all languages (e.g., *English*, *Chinese*, *Arabic*, etc.) as *second* or *foreign languages* in all countries.

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As dynamicism is the only constant in scientific research (Yan 2014), the list of possible topics that can be investigated is limitless (Powner 2017). Over time, some topics are consistently well-studied within applied linguistics, for example, *discourse analysis, reading comprehension, and self-efficacy* (Lei and Liu 2018, 2019), while others slowly or rapidly appear (*ELF*, *multilingualism*) or disappear (*optimality theory*, *noun animacy*) (Yan 2014). Nevertheless, constant change and heterogeneity, while indicative of a healthy academic discipline, inevitably means academics and students are faced with making sense of and synthesizing an ever-expanding body of new and potentially unfamiliar topics. Similarly, topic generality and unfocusedness, multiple topics within a single paper, and a lack of a clear research direction suggested by the topic make it difficult for novice and expert authors to grasp the content of new or innovative research. Complicating matters, there is a difference in the specificity of topics, with broader ones (e.g., *second language acquisition*, *language testing*, *corpus linguistics*) overlapping with the granularity levels of the research field and subfield.

Bibliometrics, or statistical analysis of scientific publications, has increasingly been applied in recent years to investigate the topics that have preoccupied applied linguists. With the exception of Lei and Liu (2018), studies have focused on topics situated in particular fields and subfields of applied linguistics, including computer-assisted language learning (Gillespie 2020; Jung 2005), English for academic purposes (Hyland and Jiang 2021), second language acquisition (Zhang 2020), teaching Chinese to speakers of other languages outside of Mainland China (Gong et al. 2018), and 'trans-' studies on writing (Sun and Lan 2021). There are also studies looking at the topics addressed within specific publications, such as *System* (Lei and Liu 2019) and *TESL-EJ* (Pearson 2022). Through the identification of popular topics as well as those in ascendance, descendance, and stagnation, deductions can be made about the state of field, subfield, or publication, allowing authors to identify main themes (Zhang 2020), stay abreast of research trends (Lei and Liu 2018), and build shared interdisciplinary knowledge bases (Gong et al. 2018), helping authors and institutions to make informed decisions about what issues to research, how, and with whom (Lei and Liu 2018).

1.1 Research Topics as Keywords from Abstracts

At the point of retrieval, the research topic is usually conveyed through three informetric properties of a research article (RA): the title (beyond the scope of the present study), abstract, and keywords (Garcia et al. 2019). The abstract provides the reader with expository information of approximately 150 to 250 words synthesizing an article's main points, of which a notable author move is 'making topic generalizations', a component of the broader rhetorical strategy of 'establishing a territory' (Swales 1990). Given that not all publications contain author-supplied keywords, abstracts constitute the primary source for determining research topics among bibliometric analyses in applied linguistics (and other fields) (Hyland and Jiang

2021; Lei and Liu 2018, 2019; Pearson 2022; Zhang 2020), with corpus methods employed to mine texts for *keywords from abstracts* (KfAbs). Such an approach necessarily limits the scope of bibliometric analysis to research documents that feature abstracts, with document types or older research articles that do not include abstracts omitted. It is also the case that a few applied linguistics publications (e.g., *ELT Journal*, *Linguistics and Education*) limit abstracts to 150 words, lowering their potential contributions to bibliometric analyses. Under this approach, corpora of RA abstracts are tagged using part-of-speech information, then submitted to software such as *AntConc* (Anthony 2018) to extract *n*-grams of usually one to five words in length (see Hyland and Jiang 2021; Lei and Liu 2018, 2019; Pearson 2022; Zhang 2020). Those that meet the minimum dispersion threshold, often set to 30 RAs with datasets of more than 10,000 records (Hyland and Jiang 2021; Lei and Liu 2018), are searched against the full selection of abstracts, with multiple occurrences treated as a single instance to reduce bias (Zhang 2020).

While keywords from abstracts address the limitations of author-supplied keywords by encompassing a broader range of topics than those supplied by authors, the approach is not without limitations. Authors have rightly searched for nominalized keyword forms (e.g., heritage language, critical discourse analysis) (Hyland and Jiang 2021; Lei and Liu 2018, 2019; Zhang 2020), although it is also the case that a few keyword structural types comprising adjectives, adverbs, and even verbs appear commonly in applied linguistics research (*higher education*, *study abroad*, *willingness to communicate*). As such, the removal of these forms through stop lists could be a source of invalidity. One way around this issue is through the use of structural pattern searching (e.g., noun + noun + noun), determined by keyword syntactic structures (Pearson 2022). Another major issue is author subjectivity in determining the relevance and appropriacy of candidate keywords, particularly noteworthy with general topics expressed as individual words (*university*, *teachers*, *volition*). Cross-checking independent ratings by multiple analysts and consultation with experts or a keyword list (Pearson 2022) can aid decision-making. Importantly, invalidity could result through corpus analyses picking up items in article abstracts that, rather than constituting meaningful research issues or concerns, are, in fact, contextual terms or noise. Given these difficulties, procedures for topic extraction through keywords from abstracts are typically described in detail in bibliometric analyses (e.g., Hyland and Jiang 2021; Lei and Liu 2018, 2019; Pearson 2022; Zhang 2020).

1.2 Research Topics as Keywords from Authors

Sometimes considered synonymous with research topics, keywords constitute "a word or group of words, possibly in a lexicographically standardized form, taken out of a title or the text of a document characterizing its content and enabling its retrieval" (ISO norm 5963; 1985). *Keywords from authors* (KfAus) are an important source of research article metadata (Uddin and Khan 2016) as well as constituting a tool for efficient and effective indexing and retrieval (Garcia et al. 2019; Lu et al.

2020; Tripathi et al. 2018). Their importance has grown considerably with the shift from hard copy to electronic research, such that most electronic search engines, databases, and journal websites now use an article's keyword list as the basis for whether and when to display the underlying research article to readers (Uddin and Khan 2016). As such, the provision of appropriate keywords directly impacts the wider dissemination of a research article, increasing the likelihood of it being cited by other authors (Lebrun 2007; Uddin and Khan 2016). A further shift that emphasizes the importance of keywords is the growth of meta-research (Farsani et al. 2021; Ioannidis 2018) or the study of research itself (of which bibliometrics is a component strand), requiring the application of carefully selected search terms (often using the keyword field in electronic indices) to convey a full or accurate representation of a body of literature (Penning de Vries et al. 2020).

Regardless of discipline, research article keywords are traditionally supplied by the author(s), summarising and representing understandings of their work (Lu et al. 2020; Uddin and Khan 2016), selected from existing research studies or the novel creation of the author(s) (Lu et al. 2020), since they are generally considered best placed to characterize their work and enhance its visibility. However, it is not always the case that author-supplied keywords faithfully represent the content of academic reports, with one study, Gil-Leiva and Alonso-Arroyo (2007), reporting a mismatch in research topics between author-supplied keywords and RA titles/abstracts. This may be because some publications impose restrictions on the number of permissible keywords (Mao et al. 2018; Tripathi et al. 2018) or that authors assign keywords based on their semantic meaning rather than following the content of the manuscript (Meng et al. 2017). Alternatively, authors may overlook certain topics (Zhang 2020) or adopt non-standard or even inappropriate terms (Lebrun 2007). Authors should pay close attention to selecting keywords used to convey their research topic(s), perhaps taking cues from recent or oft-cited contributions in the same area (Lebrun 2007). Readers may find value in utilizing the *Web of Science*'s *Keywords Plus* feature, which assigns keywords to RAs through automatic examination of the titles of cited references.

Even though authors' choices of keywords play an important role in conveying what a research article is about, they remain largely unexplored in applied linguistics bibliometric analyses (with the exception of Gong et al. 2018; Zhang 2020). A significant unknown is the extent to which research topics retrieved as keywords from authors cohere with those mined from abstracts. A lack of overlap might indicate that a singular approach does not provide a definitive interpretation of the topic(s) addressed in a body of literature and that future analyses should seek to balance interpretations by incorporating the other approach. Additionally, while stop lists usefully remove word classes that do not regularly feature in research topics, they are a blunt instrument. Uncovering prevalent syntactic structures that underly common research topics could enhance future bibliometric research by helping researchers build a more complete inventory of topic structural patterns that researchers can draw on to retrieve and filter candidate items from abstracts. Nevertheless, the value of author-assigned keywords to bibliometric analyses depends on their availability across publications, measured as presence within a research article and quantity of keywords. The present bibliometric study addresses these

uncertainties by investigating answers to the following five research questions, which guide the design of the study:

1. What is the prevalence of author-provided keywords across applied linguistics research articles published between 2001 and 2021?
2. How many words do keywords from authors feature in research articles?
3. What structural patterns do author-assigned keywords typically comprise?
4. What word classes constitute author-supplied keywords?
5. How do the most frequently explored research topics in applied linguistics, as measured by keywords from authors, compare with those retrieved as keywords from abstracts?

2 Method

2.1 Data

Since popular online research indices such as the *Web of Science, Scopus,* and *Scimago* do not delineate a discrete category of applied linguistics publications, bibliometric records were retrieved for 42 academic journals using the list of applied linguistics publications provided in Lei and Liu (2018). This list includes high-performing, international journals featuring a mix of general (e.g., second language acquisition, TESOL) and more specific areas of inquiry (e.g., language testing, English for specific purposes) that are mostly published in English. The investigation is limited to the period 2001–2021 in order to identify meaningful longer-term trends in topic prevalence within applied linguistics as well as more generalizable results concerning typical topic structural patterns, keyword frequencies per article, lengths in words, and quantities of constituent word classes (e.g., nouns, adjectives, prepositions). Bibliometric records were obtained using the 42 publications' unique ISSN identifiers from *Scopus*, chosen because of the completeness of its records and ease of exporting data into Excel for analysis. A few additional filters were applied to further limit the results. In addition to the document type 'article', which broadly aligns with empirical research, those labeled as 'review' were also included as the associated keywords provide insights into research topics in applied linguistics. Finally, a small number of studies either defined as 'in press' or not published in English were removed. Bibliometric records for the 23,481 studies were retrieved on 12th May 2022.

2.2 Procedure

Extracting Author-Supplied Keywords To first identify research topics in the form of keywords from authors, the column in the spreadsheet containing semi-colon-separated author-supplied keywords (or blanks) for each record was copied

over to Google Sheets, where a formula was used to extract unique values. These keywords were then copied back into Excel, where any duplicate values were automatically identified and removed. No effort was made to edit the keywords other than removing inverted commas in a few instances owing to compatibility issues with Excel formulae. A formula was then created to calculate the frequencies of the 28,297 discrete keywords across all articles where these had been supplied. Additional formulae were used to calculate the number of author-assigned keywords for each study (where these were present) as well as the number of words in each of the 28,297 items.

A minimum dispersion threshold across five separate research records was selected for the structural analysis of author-supplied keywords, resulting in 2324 included keywords. Coding the 25,973 keywords that occurred fewer than five times in the dataset was deemed impractical while having a prevalence of just one to four occurrences across 23,481 discrete research records meant that such keywords are unlikely to be considered prevalent topics in applied linguistics. To identify the structural patterns, the 2324 included keywords were POS-tagged using *TagAnt* (Anthony 2015):

- early_JJ childhood_NN education_NN
- lexical_JJ semantics_NNS
- higher_JJR education_NN

The coding output was checked manually, and errors or inconsistencies (particularly in the use of proper nouns and gerund forms) were corrected. The coded items were then edited to remove the keywords, leaving just the POS tagging (e.g., '_NN _NN'). The same process for identifying discrete author-supplied keywords using Google Sheets was applied to the retrieved structural patterns, resulting in the identification of 91 patterns. Among these, the frequencies of the constituent word classes were calculated manually. For example, the '_JJ _JJ _NN' pattern was coded as including two adjectives and one noun. Infrequent patterns containing '_TO' were combined with other preposition forms ('_IN'), while the one instance of a comparative adjective ('_JJR') was counted as an adjective. Separate forms for proper nouns (e.g., 'TESOL'), symbols ('/'), and borrowed words ('Kanji') were included.

Extracting Keywords from Abstracts Identifying the keywords from abstracts followed a modified version of the procedure developed by Pearson (2022). First, abstracts for each of the 23,481 studies (where available) were extracted, POS-tagged, and analyzed in *AntConc* (Anthony 2018) for the 91 structural patterns identified in the KfAus analysis. A notably higher minimum dispersion requirement across 30 separate abstracts was established, consistent with Hyland and Jiang (2021) and Lei and Liu (2018), owing to the far higher number of word tokens. Those keywords that remained (N = 5219) were imported into a spreadsheet and manually examined to ensure that they constituted valid research topics. As reported elsewhere (Hyland and Jiang 2021; Lei and Liu 2018), this process involves subjective judgment on the part of the analyst. To simplify the selection of one-word topics, candidate items were cross-referenced with the list of 2324

author-supplied keywords that met the cut and, if not present, removed. Following other studies (Lei and Liu 2018, 2019), single-word terms that were deemed too general to be meaningful (*analysis*, *development*, *time*) were omitted from the list. Care was taken to avoid double counting overlapping concepts by subtracting, for example, the frequencies for *second language acquisition* from *language acquisition*, then *second language* from the modified value for *second language acquisition*. To help ensure a robust process of inclusion/exclusion, the list of candidate KfAbs was rechecked by the author 1 month after the initial determination, with a few amendments made.

2.3 Data Analysis

In order to identify trends in keywords from authors and abstracts over time, the studies were grouped into three timeframes: 2001–2009, 2010–2015, and 2016–2021. As with Lei and Liu (2019), these are not equal ranges since the early years in the dataset include far fewer studies per year. To ensure accurate comparison across the three time periods, results were normalized using the formula, 'instances of the investigated feature / number of documents for the given period x 100'. Results for the keywords from authors analysis are presented as both raw frequencies and distributions of keyword types and tokens, while normalized frequencies of item incidence and percentage changes derived from these figures are provided in the comparative analysis of keywords from authors and abstracts.

3 Results and Discussion

3.1 Prevalence of Author-Supplied Keywords

It was found that 61.24% of documents included author-supplied keywords, indicating that their provision has not consistently been a requirement in published applied linguistics research, mirroring other disciplines (Mao et al. 2018; Onyancha 2018). As can be seen from Table 1, the majority of research published between 2001 and 2009 did not feature keywords (59.75%), with the period accounting for the majority of such studies (46.88%). There was a 33.08% reduction in the proportion of keyword-less RAs after 2009, reflective of the transition from hard copy to electronic research, where keywords may even be required (Onyancha 2018), as with *ScholarOne* and *Open Journal System*. During this period, several prominent publications implemented author-provided keywords, notably *Language Learning* (2006), *Second Language Research* (2008), and *Applied Psycholinguistics* (2018). Although the number of raw records without author keywords remained reasonably constant from 2010 to 2021, the rapid expansion of the literature in recent years means the share of such research has dropped by 6.52%. Yet, over one-quarter

Table 1 Total number of research documents, with and without author-supplied keywords

	All	No author-provided keywords		With author-provided keywords	
Period	*N*	*N*	%	*N*	%
2016–2021	9032	2409	26.67%	6623	73.33%
2010–2015	7307	2425	33.19%	4882	66.81%
2001–2009	7142	4267	59.75%	2875	40.25%
Total	23,481	9101		14,380	

Table 2 Research documents with two or more author-supplied keywords

	All records		2001–2009		2010–2015		2016–2021	
No. of keywords	*N*	%	*N*	%	*N*	%	*N*	%
2	92	0.64%	30	1.04%	25	0.51%	37	0.56%
3	1258	8.74%	418	14.54%	398	8.14%	442	6.67%
4	3015	20.94%	591	20.56%	1044	21.34%	1380	20.81%
5	5091	35.36%	805	28.00%	1597	32.65%	2689	40.56%
6	3281	22.79%	625	21.74%	1194	24.41%	1462	22.05%
7	823	5.72%	171	5.95%	307	6.28%	345	5.20%
8	381	2.65%	102	3.55%	153	3.13%	126	1.90%
9	198	1.38%	55	1.91%	76	1.55%	67	1.01%
10	144	1.00%	40	1.39%	54	1.10%	50	0.75%
11	49	0.34%	19	0.66%	18	0.37%	12	0.18%
12+	33	0.23%	10	0.35%	13	0.27%	10	0.15%

of retrieved research in the most recent timeframe did not feature keywords from authors. This might be because many of the publications that do not supply keywords (e.g., *Applied Linguistics, Language Acquisition, Language Teaching*) are highly prestigious, perhaps operating under the assumption that publication in such a venue is sufficient to ensure article visibility.

Table 2 outlines the frequencies and distributions of the retrieved research documents that included various quantities of author-supplied keywords. It can be seen that in 79.09% of papers, authors opted to include four to six terms, with the most popular configuration being five keywords (35.36%), mirroring other social science fields (Mao et al. 2018; Tripathi et al. 2018). At the extreme ends, very few studies provided one or two keywords (with records featuring one keyword being omitted because of their scarcity), while there was a notable drop-off in frequency above six author-provided terms. That said, over 200 research records included 10 or more keywords suggestive of broad, diverse research aims or a desire to improve the paper's visibility. There is a clear growth tendency in the provision of five keywords (up by 12.56%), perhaps reflecting greater standardisation across journals and publishers, while the proportions of studies opting for four or six keywords fluctuated slightly. Patterns of 1–3 and 7+ keywords exhibited reductions across the timeframe (with the exception of a slight temporary rise in the number of studies providing seven keywords in 2010–2015). The most notable decline is in the

provision of three keywords, falling from 14.54% of studies to 6.67%, perhaps because three terms fail to sufficiently represent the content of research.

3.2 Keyword Lengths

Frequency counts (types and tokens) of all 28,297 author-provided keywords were calculated for keyword length (measured as the number of words they contained, excluding punctuation symbols). The results for keywords of one to five words in length (the most frequent types) are displayed in Table 3. The results provide tentative evidence that applied linguists are adopting keyword forms characterized by greater length and, thus, precision. Single-word terms, although the second most popular choice, exhibited a 6.01% reduction in token frequency. In contrast, two- and three-word items showed moderate increases of 3.49% and 2.87%, respectively. With just 121 types and 127 tokens, keywords that included seven or more words (e.g., *academic discourse socialization in a second language, learner attention [polyfocal, multimodal attending] in online education*) were rare. It, therefore, appears that applied linguists are reluctant to employ very precise keywords, perhaps because, by virtue of their low frequency (and therefore low dissemination and reduced ability to electronically link to other research documents), lengthy terms are less attractive (Garcia et al. 2019; Uddin and Khan 2016). Alternatively, it may be out of awareness that a high volume of metadata could be cognitively overloading or off-putting for readers (Uddin et al. 2015). The notable 14.33% gap in type and token proportion for one-word items suggests some terms (e.g., *bilingualism, identity, motivation, writing*) commonly recur in research articles and are, thus, integral to the field. As such, single-word keywords will probably continue to remain prominent among author-supplied keywords in applied linguistics RAs.

3.3 Structural Patterns of Author-Provided Keywords

The 2324 author-supplied keywords that occurred with a minimum dispersion across at least five RAs were analyzed for their structural forms (Table 4). The results revealed the presence of a surprising 91 discrete patterns, albeit 48 of these occurred only once. While most singularly occurring structural types featured fewer than 20 tokens across the dataset, two notable forms included over 100 tokens: *study abroad* (noun + adverb; 162) and *higher education* (comparative adjective + noun; 100). Unsurprisingly, since it accounted for five of the top 10 most frequently occurring author-supplied keywords, the individual noun constituted the most common keyword by type (25.13%) and, more noticeably, token (30.73%). Nevertheless, the single noun keyword witnessed a consistent and notable (6.54%) decline over time, as researchers opted for slightly longer and more precise terms. Conversely, the second most common form, the adjective + noun pattern, showed a

Table 3 Frequencies of keyword-from-author structures featuring one to five words (types and tokens)

	Types		Tokens		Tokens (2001–2009)		Tokens (2010–2015)		Tokens (2016–2021)	
No. of words	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
1	5583	19.73%	25,322	34.06%	5607	37.80%	8936	34.91%	10,779	31.79%
2	14,743	52.10%	35,697	48.02%	6792	45.79%	12,194	47.64%	16,711	49.28%
3	5201	18.38%	9277	12.48%	1580	10.65%	3113	12.16%	4584	13.52%
4	1882	6.65%	2661	3.58%	572	3.86%	889	3.47%	1200	3.54%
5	572	2.02%	971	1.31%	192	1.29%	317	1.24%	462	1.36%

Table 4 The 10 most frequent keyword-from-author structural types

	Types		Tokens		Tokens (2001–2009)		Tokens (2010–2015)		Tokens (2016–2021)	
Structure	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
_NN	584	25.13%	12,401	30.73%	2709	35.18%	4319	31.07%	5373	28.64%
_JJ _NN	476	20.48%	7028	17.41%	1070	13.89%	2306	16.59%	3652	19.47%
_NN _NN	349	15.02%	6552	16.23%	1288	16.73%	2267	16.31%	2997	15.98%
_NP	149	6.41%	3561	8.82%	656	8.52%	1340	9.64%	1565	8.34%
_JJ _NNS	142	6.11%	1684	4.17%	272	3.53%	582	4.19%	830	4.42%
_NNS	125	5.38%	1781	4.41%	419	5.44%	592	4.26%	770	4.10%
_JJ _NN _NN	101	4.35%	1910	4.73%	311	4.04%	673	4.84%	926	4.94%
_NN _NNS	97	4.17%	1550	3.84%	360	4.67%	538	3.87%	652	3.48%
_JJ	38	1.64%	483	1.20%	80	1.04%	164	1.18%	239	1.27%
_NN _NN _NN	27	1.16%	291	0.72%	39	0.51%	94	0.68%	158	0.84%

5.58% rise, suggesting researcher efforts to provide more descriptive keywords (likely for boosting article visibility). This is supported by respective 0.89% and 0.90% increases in other forms containing adjectives: adjective + plural noun (*individual differences*) and adjective + noun + noun (*computer-assisted language learning*). Nevertheless, present in the top 10 most common KfAus only twice (*academic writing*, *bilingual education*), the adjective + noun token count falls notably short of single nouns (by 5373) and is only slightly higher than noun + noun combinations (+1.18%).

3.4 Word Classes Present in Keywords from Authors

Frequencies of word classes present in author-supplied keywords were calculated from the uncovered structural patterns (Table 5). Reflective of their role in condensing information (Cheng et al. 2012; Meng et al. 2017), single and plural nouns were prevalent across author-supplied keywords, accounting for 70.96% of all component forms of keyword types. Nouns as tokens represented a slightly higher proportion (72.91% overall), although they exhibited a reduction across the timeframe from 75.66% of all constituent words to 71.62%. This phenomenon likely reflects the reduction in single noun keywords, offset by increases in keyword forms that include multiple nouns. Proper nouns tended to encompass the countries, nationalities, and languages investigated in research along with field-specific abbreviations (*L2*, *ELL* [English language learner]*)* and occurred with a far lower incidence than ordinary nouns. While they witnessed increases in raw frequency counts as an overall share of word classes, proper nouns demonstrated a slight fall of 0.38% across the periods. The only other word class with a sizeable prevalence was adjectives, accounting for 22.42% of types and 19.40% of tokens. The rise in adjective incidence, from 16.31% of word classes in 2001–2009 to 20.99% in 2016–2021, boosted by the increasing phenomenon of adjective + adjective + (plural) noun combinations (e.g., *complex dynamic systems*, *oral corrective feedback*), further attests to the increasingly descriptive nature of author-supplied keywords. Prepositions were the only other form to constitute more than 1% of types and tokens, reflective of their presence in multi-word structures (e.g., *Chinese as a second language*, *focus on form)*.

3.5 Research Topics as Keywords from Authors and Keywords from Abstracts

Prevalent Research Topics As reported in other disciplines (Gil-Leiva and Alonso-Arroyo 2007), a mismatch between author-supplied keywords and abstracts was uncovered. A surprising 48.62% of keywords were not present in the accompanying RA abstract, meaning rather different bodies of literature may be retrieved if

Table 5 Frequencies of word classes across author-assigned keywords (types and tokens)

	Keyword types		Keyword tokens		Tokens (2001–2009)		Tokens (2010–2015)		Tokens (2016–2021)	
Word class	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Noun	2830	70.96%	48,260	72.91%	9256	75.66%	16,466	73.22%	2253	71.62%
Adjective	894	22.42%	12,842	19.40%	1995	16.31%	4243	18.87%	6604	20.99%
Proper noun	151	3.79%	3574	5.40%	657	5.37%	1347	5.99%	1570	4.99%
Preposition	54	1.35%	770	1.16%	190	1.55%	190	0.84%	390	1.24%
Conjunction	24	0.60%	132	0.20%	44	0.36%	44	0.20%	44	0.14%
Determiner	21	0.53%	371	0.56%	65	0.53%	118	0.52%	188	0.60%
Symbol	10	0.25%	60	0.09%	5	0.04%	5	0.02%	50	0.16%
Verb	2	0.05%	12	0.02%	6	0.05%	4	0.02%	2	0.01%
Foreign word	1	0.03%	7	0.01%	2	0.02%	2	0.01%	3	0.01%
Adverb	1	0.03%	162	0.24%	13	0.11%	69	0.31%	80	0.25%

a reader chooses to search in only the keyword or abstract fields of an online search index such as *Scopus* or the *Web of Science*.

Table 6 outlines the 10 most frequently explored topics in applied linguistics research according to keywords from authors. Consistent with the central aim of applied linguists to identify, investigate, and offer solutions to language-related problems, the prevalence of topics related to language contact (*bilingualism*, *multilingualism*, *bilingual education*, *second language acquisition*) indicate that authors have positioned their research within the enduring concerns of additional language acquisition, learning, and use. Interestingly, none of these topics featured in the top 10 keywords from abstracts (Table 7). In contrast, with the exception of *second language*, popular keywords from abstracts often encompass practice-orientated concepts central to language learning (including the term itself), such as *performance*, *attention*, *cognitive*, *interaction*, and *strategies*. Given the high frequency of *children*, it is evident that much practice-orientated research addresses the language learning behaviors of young learners. Its absence from the top 100 KfAus might indicate that not all authors view providing information about the participants of research or producers of research artifacts as a valid or suitable keyword.

The high frequency of *Spanish* as an author keyword appears unexpected, indicating a concentrated and enduring research interest in the language and its speakers. Its pre-eminence is mirrored in the results for the keywords from abstracts, where *Spanish* appears as the ninth most popular topic, accompanied by the frequent bundles, *learners of Spanish* (118 raw counts), *Spanish speakers* (77), and *Spanish learners* (67). Given its status as a global second language and the primary language of academia, it may be surprising that English 'only' placed sixth on the most frequent author-assigned keywords (and not at all among the top 10 keywords from abstracts). However, authors likely opted for more specific topics incorporating the term, such as *EFL* (English as a foreign language), *English for academic purposes*, and *EAP* (English for academic purposes), which all featured within the top 40 keywords from authors. While *language policy* and *identity* have previously been identified as indicative of the growing interest in socio-economic-ideological concerns (Lei and Liu 2018), the results of this study suggest that applied linguists have long held an interest in these areas. This is somewhat borne out in the results for keywords from abstracts (*language policy*; 324 raw instances, *identity*; 575), albeit neither exhibited the significant increases uncovered by Lei and Liu (2018) or Hyland and Jiang (2021) and Lei and Liu (2019), perhaps because of the wide timeframe or diverse publication list incorporated in this study.

Another interesting feature of the most prevalent research topics is that most terms measured as author keywords exhibited sizeable increases in interest, with the exception of *bilingual education*, *language policy*, and *identity*. This indicates that these topics continue to engage and preoccupy new and veteran researchers in the field and that authors may be aware that such topics are popular and visible keywords, thus helpful for research article retrievability (Lebrun 2007). In contrast, there was noticeably less movement in the most popular keywords from abstracts, suggesting that authors do not appear to view the abstract as a venue to load topic

Table 6 Samples of frequently explored topics according to keywords from authors

	2001–2009		2010–2015		2016–2021		
Keyword	raw	normed	raw	normed	raw	normed	% change
The top 10 most frequently explored topics							
Bilingualism	75	10.50	184	25.18	369	40.85	289.05%
Second language acquisition	47	6.58	155	21.21	167	18.49	180.97%
Spanish	31	4.34	161	22.03	164	18.16	318.33%
Multilingualism	29	4.06	83	11.36	168	18.60	358.09%
Identity	53	7.42	105	14.37	112	12.40	67.10%
English	44	6.16	94	12.86	122	13.51	119.25%
Academic writing	41	5.74	72	9.85	125	13.84	141.08%
Language policy	52	7.28	79	10.81	104	11.51	58.15%
Bilingual education	60	8.40	72	9.85	99	10.96	30.47%
Motivation	39	5.46	75	10.26	103	11.40	108.84%
The 10 topics that exhibited the largest increases							
English language arts	1	0.14	1	0.14	36	3.99	2746.68%
Crosslinguistic influence	1	0.14	15	2.05	27	2.99	2035.01%
Teacher agency	1	0.14	1	0.14	27	2.99	2035.01%
Eye tracking	1	0.14	7	0.96	26	2.88	1955.93%
Literacy teaching	1	0.14	0	0.00	25	2.77	1876.86%
English as a lingua franca	1	0.14	13	1.78	24	2.66	1797.79%
Language dominance	1	0.14	13	1.78	24	2.66	1797.79%
Executive control	1	0.14	7	0.96	24	2.66	1797.79%
Cognates	1	0.14	7	0.96	22	2.44	1639.64%
Willingness to communicate	1	0.14	14	1.92	20	2.21	1481.49%
The 10 topics that exhibited the largest decreases							
Cut and break	16	2.24	0	0.00	0	0.00	−100.00%
Separation events	15	2.10	0	0.00	0	0.00	−100.00%
Verb semantics	14	1.96	1	0.14	0	0.00	−100.00%
Internet	11	1.54	4	0.55	0	0.00	−100.00%
Features	8	1.12	3	0.41	0	0.00	−100.00%
Learner strategies	8	1.12	3	0.41	0	0.00	−100.00%
Functional categories	7	0.98	2	0.27	0	0.00	−100.00%
Chinese language education	6	0.84	1	0.14	0	0.00	−100.00%
No child left behind	6	0.84	1	0.14	0	0.00	−100.00%
Minimality	6	0.84	0	0.00	0	0.00	−100.00%

Italics denote presence in the top 40 keywords from abstracts

keywords that could enhance the discovery and retrieval of the article. This is an important consideration for future researchers since meta-researchers (especially of systematic reviews and bibliometric analyses) increasingly look to the abstract (not always in conjunction with author-assigned keywords) to identify and retrieve relevant literature that addresses their research problem or issue.

Table 7 Samples of frequently explored topics according to keywords from abstracts

	2001–2009		2010–2015		2016–2021		
Keyword	raw	normed	raw	normed	raw	normed	Normed change
The top 10 most frequently explored topics							
Second language	631	8.84	787	10.77	1203	13.32	50.76%
Language learning	450	6.30	651	8.91	801	8.87	40.75%
Attention	361	5.05	444	6.08	592	6.55	29.67%
Performance	342	4.79	431	5.90	584	6.47	35.03%
Cognitive	301	4.21	348	4.76	552	6.11	45.01%
Children	356	4.98	407	5.57	443	4.90	−1.60%
Discourse	388	5.43	352	4.82	446	4.94	−9.11%
Interaction	360	5.04	348	4.76	423	4.68	−7.09%
Spanish	292	4.09	353	4.83	436	4.83	18.07%
Strategies	349	4.89	315	4.31	415	4.59	−5.97%
The 10 topics that exhibited the largest increases							
Thematic analysis	1	0.01	8	0.11	43	0.48	4200.00%
EMI	2	0.03	4	0.05	75	0.83	3650.00%
Semiotic resources	1	0.01	10	0.14	35	0.39	3400.00%
Bilingual advantage	1	0.01	16	0.22	30	0.33	2900.00%
DDL	1	0.01	8	0.11	28	0.31	2700.00%
Student engagement	1	0.01	8	0.11	27	0.30	2600.00%
Teacher agency	1	0.01	4	0.05	25	0.28	2400.00%
Teacher identity	1	0.01	4	0.05	25	0.28	2400.00%
Inhibitory control	1	0.01	6	0.08	22	0.24	2100.00%
Entrenchment	1	0.01	12	0.16	21	0.23	2000.00%
The 10 topics that exhibited the largest decreases							
Foreign language	181	2.53	77	1.05	4	0.04	−98.25%
Optimality theory	19	0.27	12	0.16	2	0.02	−91.68%
Glides	8	0.11	1	0.01	1	0.01	−90.12%
Foreign language teacher	19	0.27	11	0.15	3	0.03	−87.51%
Discourse community	15	0.21	5	0.07	3	0.03	−84.19%
Functional categories	20	0.28	9	0.12	5	0.06	−80.23%
ESL learners	61	0.85	25	0.34	16	0.18	−79.26%
Language schools	11	0.15	10	0.14	3	0.03	−78.43%
Optimality	24	0.34	15	0.21	7	0.08	−76.94%
Computers	32	0.45	15	0.21	10	0.11	−75.29%

Italics denote presence in the top 40 keywords from authors

Research Topics That Are Increasing A clear majority of keywords from abstracts (79.41%) increased in prevalence over the timeframe. In contrast, fewer than half of keywords from authors saw a rise (46.17%), perhaps owing to a cap on their frequency by the journal or variations in the whims of authors. Although the research topics that exhibited the most significant increases over the last 20 years

differed almost entirely depending on whether they were KfAus or KfAbs (except for *teacher agency*), most fall into three discernible themes. The most notable are new language teaching/learning/research practices and issues that have gained attention (*crosslinguistic influence*, *English language arts*, *EMI* [English medium instruction], *student engagement*, *semiotic resources*, *and teacher agency*). Some of these concerns emerged in response to enduring and, perhaps, stubborn language teaching and learning problems, such as *student engagement* to explore why some language-related behaviors and attitudes facilitate language learning more than others, *teacher agency* as a conceptual means to investigate how teachers can be constrained in carrying out their work and responding to professional challenges, and *willingness to communicate* to explain how and why some learners make greater use of the communicative opportunities presented to them. Several prolific new topics are psycholinguistic (*semiotic resources*, *inhibitory control, executive control*), indicating increasing interest in the cognitive and metacognitive processes that make it possible for individuals to master and use languages, albeit the focus of such work often has little in common with teaching-orientated research (Zhang 2020). Other topics of this theme reflect changes in the way languages are taught and learned in classroom settings (*EMI*) or how teaching and learning are conceived (*English language arts*, *literacy teaching*), driven by new economic and social realities, educational policy-making, or changes in professional practice.

A second category of burgeoning applied linguistics research topics are socio-economic-ideological concepts that address language-related problems and concerns from the perspective of power relations, wealth and social inequalities, and globalization (*bilingual advantage*, *English as a lingua franca*, *language dominance*, *teacher identity*). Mirroring the findings of Lei and Liu (2018, 2019), albeit an author-supplied keyword, *English as a lingua franca* features prominently, reflecting the increased entrenchment of English as a global second language of communication and the *de facto* language of academia across the period. This is also reflected in the heightened interest in *language dominance*, as communication in English denotes a higher social and political class in some cultures and has increasingly usurped traditionally taught second languages. The growing prevalence of this theme of topics reflects changes within higher education that have accelerated in recent years, including the adoption of postmodern epistemologies, critical emancipatory perspectives and theories, and intersectionality. Such research complements the knowledge gained from the study of language systems by providing broader, contextualized perspectives on the issues involved in language teaching, learning, and use. Nevertheless, not all journals among the 42 investigated accept such studies (e.g., *Cognitive Linguistics*, *Corpus Linguistics and Linguistic Theory*, *Second Language Research*), perhaps limiting this as a growth area.

A third group of topics that exhibited dramatic rises relate to methodological development and innovation (*thematic analysis*, *eye tracking*, *DDL* [data-driven learning]). While not topics in the strictest sense (Hyland and Jiang 2021), methodological concepts inform how applied linguists investigate phenomena. The remarkable rise in *thematic analysis* is indicative of the wider adoption of qualitative and

mixed methods inquiries in applied linguistics (Benson et al. 2009; Richards 2009). The popularity of the approach can likely be explained by its theoretical flexibility and ease of application versus other, more complex analytical approaches, such as grounded theory. As found in other bibliometric studies (Lei and Liu 2018, 2019; Zhang 2020), methodological innovation in applied linguistics stems from the increasing application of novel technologies, notably *eye tracking* and *DDL*, which may also have been propelled by the improved performance and prestige of publication venues dedicated to the interface of language and technology (Zhang 2020), most of which were established in the 1990s (Lei and Liu 2019). Nevertheless, with the exception of a few well-known social networking services, the widespread adoption of certain technologies can be slow or haphazard. Thus, it may take time before some technology-related concepts that appeared as keywords from authors or abstracts during 2016–2021 that were not present during the earlier periods feature more prominently in research, for example, *digital multimodal composing* and *keystroke logging*.

Research Topics That Are Decreasing Author-assigned keywords were more likely to exhibit reductions in use compared with keywords from abstracts. Almost double the proportion (29.49% versus 15.87%) witnessed a drop, while the relatively rare phenomenon of disappearance from the dataset altogether (4.51% of author-supplied keywords) was almost unheard of for keywords from abstracts. Topics as keywords from authors and abstracts that exhibited the largest decreases featured somewhat different thematic properties to those that substantially increased. As reported elsewhere (Lei and Liu 2018; Zhang 2020), several topics that witnessed the sharpest reductions were related to the study of formal linguistic properties (*cut and break*, *separation events, verb semantics, glides*).

Interestingly, a number of these terms were inflated in the keywords from the authors list owing to two journal special issues. It seems authors either opted for or were required to utilize standardized iterations of such terms, in contrast to the more varied abstracts (e.g., *cutting and breaking*, *cutting, breaking*, *and tearing*). One reason for the reduction in topics related to language properties could be that such studies are difficult to obtain external funding for since they often lack measurable forms of 'real impact', notably pedagogical implications and engagement with the wider public, qualities favored by award panels. It could also be that journals' aims and scopes have evolved over the years, with publications more readily accepting applied studies since they may garner more citations than theoretical works and bridge the research-practice divide, engaging a wider readership.

Another thematic trend among topics with falling popularity is the disappearance of rather general terms that, while they may have been acceptable in relation to the nature and scope of the literature at the time, lack the precision to be effective keywords in the current era of burgeoning scientific information (e.g., *computers*, *Internet*, *functional categories*, *features*). Such topics have likely been superseded by more specific and meaningful terms to researchers and practitioners (e.g., *computer-assisted language learning*, *discourse functions*). A third thematic category of poorly performing topics relate to theories, perspectives, and policies that, for one

reason or another, are no longer in vogue (*optimality theory*, *No Child Left Behind*), a phenomenon not unique to either keywords from abstracts or authors. It should be noted that the reasons underlying trends in topic prevalence are not always easy to explain (Lei and Liu 2019; Pearson 2022). It is unclear why the author-assigned keywords, *foreign language teacher* and *discourse community* and the keywords from abstracts, *learner strategies* and *Chinese language education* performed so poorly. It may be that authors adopted parallel terms (e.g., *Chinese a second/foreign language*, *English as a second language learners*) and that interest in such areas, in fact, remains healthy.

4 Conclusion

This study's findings are limited by several design decisions relating to the determination and retrieval of keywords from authors and abstracts. A minimum dispersion of five was selected for the structural analyses of KfAus, removing 25,973 unique terms. While the low-frequency counts indicate that these are not popular research topics, their inclusion in the structural analysis would impact the uncovered patterns, certainly in terms of the range identified and their type and token distribution. Lowering the minimum dispersion would also affect the retrieved keyword from abstracts since these were based on the structural patterns of KfAus with a minimum dispersion of above four. Concerning KfAbs, difficult interpretive decisions determined whether some retrieved terms constituted meaningful topics (Pearson 2022). Only the uncovered single-word terms that also appeared as KfAus with a minimum dispersion of five and above were retrieved to facilitate the analysis. While this means some concepts may have been missed, many single items on the full list of 28,297 KfAus doubled up as very general words (*I*, *some*, *talk*) and would have severely skewed the KfAb results. It should also be mentioned that (for reasons of practicality) no manual checking of the accuracy of POS tagging of the corpora of abstracts was undertaken. It is possible that tagging errors or inconsistencies (e.g., *English* as an adjective versus a proper noun) could have influenced the frequencies and distributions of the uncovered KfAu structural patterns and the KfAb results.

This study uncovered several trends in using author-supplied keywords in applied linguistics research between 2001 and 2021. It was found that keywords have become more prevalent across publications, although there are still a few prestigious venues that continue to resist their implementation, potentially affecting the visibility of research. Despite variations, more articles are adopting the standard of five author-assigned keywords, with a gradual movement away from general single-word terms (particularly individual nouns) to more precise and descriptive two- and three-word constructions that draw predominantly on (ordinary and proper) nouns and adjectives. Further research is required to investigate if scholars and students of applied linguistics are predisposed towards particular keyword structures and configurations, measured quantitatively through the citation counts of articles or qualitatively by querying readers' reactions to keywords using think-aloud protocols.

Despite overlapping thematic properties, significant variations were uncovered among prevalent, rising, and falling research topics measured by authors' and abstract keywords. The reasons for this mismatch can be attributed to author/publication and study-related factors. The former include inconsistent journal support for author-assigned keywords across the timeframe, limitations on the frequencies of keywords imposed by journals, and authors mischaracterizing their research, perhaps in a bid to enhance article visibility. The reasons may also relate to the design of this study. The corpus analysis may have overstated topics that constitute background information or noise upon manual examination of the abstract. It may also be that keywords from abstract forms are conveyed with greater flexibility, thus diluting frequency counts of particular items (especially multi-word concepts).

Author-supplied keywords have played a limited or non-existent role in bibliometric research in applied linguistics. I contend that they encompass both an important methodological tool to support other measures and a source of insight into the state of a literature body. Concerning the former, KfAus constitute a useful initial reference to identify search terms to define and retrieve a body of literature for analysis, particularly when a research area cuts across a range of publications. Additionally, KfAus can support topic identification through KfAbs by providing the analyst with an inventory of common structural forms, bypassing the need for an unwieldy stop list. KfAus also help facilitate decision making in the manual verification of candidate research topics, particularly concerning more contentious one-word items. Finally, consumers of research should be aware that applying search terms to the abstract (and indeed, author keyword) field alone could lead to missed studies, creating a false impression of the state of literature being conveyed (Penning de Vries et al. 2020).

There are also good reasons why future studies may wish to include KfAus as a focal area for analysis in its own right. Given the uncovered mismatch between keywords from authors and abstracts, new research ought to consider both data sources in order to provide a more complete and accurate account of research topics under investigation in a particular area. Additionally, KfAu analysis is important to uncover trends in how authors position and characterize their work (Lu et al. 2020; Uddin and Khan 2016), a useful endeavor given the need for writers of research reports to carefully attend to factors that might enhance manuscript visibility. Concomitantly, particular author-selected keywords or structural patterns may be conducive to enhanced article impact (as measured through document citations). Factors that mediate research impact, such as the keywords themselves, their length, complexity, or specificity, constitute fruitful areas of future bibliometric research in applied linguistics.

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A Bibliometric Analysis of Mixed Methods Research (MMR) in Applied Linguistics (AL)

Hessameddin Ghanbar and A. Mehdi Riazi

1 Introduction

The term "bibliometric" comes from the French word "bibliométrie" (see Otlet 1934), which has been translated into English by Rousseau (2014) as "the measurement of all aspects related to the publication and reading of books and documents" (p. 425). Also, Pritchard (1969), in a way, modernized this delineation and technically defined it as "the application of mathematical and statistical methods to books and other means of communication" (p. 349). It should be said that bibliometric analysis is interchangeably used with scientometrics and encompasses a wide range of methods and techniques. For example, one of its techniques, author co-citation analysis (ACA), aims "to map knowledge domains by quantifying the relationship between co-cited author pairs" (Wang et al. 2018, 70). In addition, in some publications, researchers have used document co-citation analysis (DCA) more specifically to identify documents that have received peer recognition through citation patterns. Trujillo and Long (2018) stated that when researchers cite a particular source, they indicate that it has been critical to them. Through this practice, we can understand significant past contributions within a discipline. Indeed, the citation performance of publications depends heavily on the academic fields. Another widely utilized bibliometric technique has been the citation analysis of the impact (Chang et al. 2015), wherein the impact of authors, publication venues, academic institutions, and documents have been assessed in terms of different citation metrics (see methodology section of this chapter for more information on these metrics).

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Bibliometrics researchers usually use one of the three databases to retrieve documents and subject them to bibliometric analysis. These three sources are Web of Science (WoS), Scopus (Elsevier), and Google Scholar. There are advantages and disadvantages regarding which source to use. For example, Google Scholar can provide free-of-charge sources using Google's search engine (Aguillo 2012), covering a wide range of scholarly works such as peer-reviewed papers, books, preprints, abstracts, etc. However, its use for a bibliometric study may have several drawbacks and complications (see Bar-Ilan 2009; Kousha and Thelwall 2008; White 2006). For example, covering a wide variety of scholarly and non-scholarly works might be an Achilles' heel of this database, as identifying valuable and credible resources would be strenuous and time-consuming, resulting in its becoming "a noisy database" (Aguillo 2012, p.344). Additionally, Google Scholar not only does not distinguish between academic and non-academic citations but does not provide information relating to the co-citation of articles (Zhang 2020) and, hence, does not lend itself very well to a co-citation analysis. We opted for WoS, given its comprehensiveness and relevance to this work. As Roemer and Borchardt (2015) and Zhang (2020) pointed out, WoS now has more than 7000 subscribers, twice as many as Scopus, its well-known rival in scientometrics, which is why we opted for it and preferred it over Scopus. According to Clarivate's official website, WoS Core Collection now has encompassed more than 21,100 peer-reviewed, high-quality scholarly outlets in various fields, ranging from arts and humanities to social sciences and sciences; apart from this, WoS also contains conference proceedings and book data.

Bibliometric researchers may use words in keywords, titles, and abstracts of publications to make inferences about the academic fields. However, the trend in bibliometrics is to analyze the references of the publications through co-citation analysis. Considering the affordances of bibliometric analysis of scholarly works and co-citation analysis, this line of research has received traction in different academic disciplines in recent years. Applied Linguistics (AL) has not been an exception following this line of research. Several recent publications (e.g., Amini Farsani et al. 2021; Hyland and Jiang 2021; Lei and Liu 2019a, b; Liu and Hu 2021; Zhang 2020) have focused on bibliometrics and co-citation analysis in AL. These studies will be reviewed in the background of the study section. While the outcomes of these studies have contributed to bibliometric analysis in AL, there still needs to be a gap in this literature. The gap regards the bibliometric status of mixed methods research (MMR) in AL.

Notwithstanding this fact that MMR studies in AL have been reviewed in some systematic reviews so far (e.g., Amini Farsani et al. 2021; Hashemi and Babaii 2013; Ghanbar and Rezvani 2023a, b; Riazi et al. 2018; Riazi et al. 2020; Riazi, Ghanbar, and Marefat in press), no scientometric studies have been conducted to portray and analyze the intellectual structure of the field regarding this burgeoning research methodology. In addition, the previous works, except for Hashemi and Babaii 2013, have not directly targeted MMR, and they mainly provided the frequency of MMR studies in the field. It is thus timely to conduct a bibliometrics analysis of the scholarly works utilizing MMR to shed light on the research and publication trends,

scholarly impacts, and citation patterns. Our chapter thus aims to fill this niche by reporting a scientometric analysis of MMR studies from 1984 to 2022, covering 38 years.

2 Background to the Study

As discussed earlier, bibliometric techniques have become increasingly popular in tracking knowledge dissemination and investigating its multidimensional aspects in the field. For example, Lei and Liu (2019a, b) conducted two bibliometrics studies. The first study investigated the System's journal contributions to disseminating themes and evolving patterns over 40 years (1973–2017). In particular, the study identified and examined the journal's most frequently discussed topics, most highly cited articles, and most highly cited references and authors. In the second study, Lei and Liu again used bibliometric analysis to investigate research trends in AL from 2005 to 2016.

Similarly, Zhang (2020) conducted a bibliometric analysis of second language acquisition (SLA) between 1997 and 2018. Through a systematic review of the field, the researcher looked for the major trends in SLA. Zhang used the Web of Science (WoS) to retrieve relevant data and conduct co-citation and keyword analysis. Through the bibliometric analyses, the researcher identified the research topics, prominent scholarly documents, authors, research institutions, and geographic regions that influenced the SLA field over the 1997–2018 period. The study also reported significant changes and new trends in the field.

In 2021, three bibliometric studies were published, showing the AL researchers' attention to this new line of research. Hyland and Jiang (2021) focused on English for Specific Purposes (ESP) and, through bibliometric analysis, showed how ESP emerged as a discipline. In fact, Hyland and Jiang used bibliometric techniques to track changes in ESP research to achieve their goal. They analyzed 3500 articles published since 1990, focused on ESP, and indexed in the Social Science Citation Index. They identified the topics, authors, publications, journals, and countries that were most influential in ESP. Their results showed that classroom practices remain central to the ESP discipline and that there has been a consistent interest in specialized texts, mainly written texts. Other prominent topics were higher education and business English and increasing attention to academic and workplace discourses. The range of authors shows the global interest in these topics, the diversity of geographical places, and the uptake of papers in a range of fields.

Liu and Hu (2021) also focused on ESP. They conducted a co-citation analysis to map the field of ESP over the 1980–2018 period. The researchers retrieved 1092 articles published in two flagship journals and their 25,147 unique references. They conducted a co-citation analysis and identified 11 major clusters of co-cited references, representing the field's major areas of research. Liu and Hu could map the 11 clusters against four evolutionary stages of the ESP field. The first evolutionary stage was named conceptualizing stage (the 1970s–1990s), the second maturing

stage (1990s–2000s), and the third methodological development (e.g., genre-based, corpus-based, contextual, and critical approaches), and the flourishing stage (2000s-) steering a diversity of research interests (e.g., move analysis, cross-disciplinary and cross-linguistic variation, lexical bundles, vocabulary lists, metadiscourse, and academic writing in a global context). Through co-citation analysis, the researchers also identified 52 landmark studies, 11 of which experienced recent citation bursts, indicating current research interests of the field. This bibliometric and co-citation analysis provides a systematic account of the ESP field and complements existing narrative reviews.

Amini Farsani et al. (2021) conducted a research synthesis and bibliometric analysis. Their study focused on methodological orientations, academic citations, and scientific collaboration in AL. The researchers retrieved 3992 AL articles published from 2009 to 2018 in 18 leading journals. They reviewed the articles and manually coded the methodological orientations and scientific collaboration through co-citation analysis. Regarding methodological orientations, they found that the most prevalent research approach was quantitative (42.6%), followed by mixed-methods research (25.9%) and qualitative research (24.9%). They also found that a small group of the articles (2.2%) were systematic review papers. However, they found that systematic reviews received higher citations than empirical articles. Regarding research collaboration, they found that educational and psychological topics received the highest collaboration rate among AL researchers. Also, the collaboration rate was significantly higher in quantitative studies than in other research approaches.

Mixed methods research (MMR) has gained popularity among researchers in AL and, more broadly, in all other disciplines. MMR was developed to solve the problem of "adversarial incompatibility" (Riazi and Candlin 2014, p.138) of quantitative and qualitative research methods. As such, MMR mixes the two methodological paradigms to develop a complete understanding of the social phenomenon and is now referred to as "the third methodological movement" (Tashakkorie and Teddlie, 2003, cited in Riazi and Candlin 2014, p.138). Regarding the purpose for which the two methods are mixed, Greene et al. (1989) conducted a literature review and ended up with an MMR purpose typology. They Reviewed 57 empirical studies in the field of evaluation covering the period of 1980–1988. Based on their review, Greene et al. (1989) identified five purposes for which MMR researchers mixed quantitative and qualitative data and analysis. These purposes are (1) triangulation, (2) complementarity, (3) development, (4) initiation, and (5) expansion.

As can be seen from the brief review of the selected bibliometric studies, MMR has not been the focus of this line of research. The only study that touched on methodological orientation is Amini Farsani et al. (2021). However, this study focused on methodological prevalence rather than publication trends, citation analysis of impacts, and co-citation analysis of MMR studies. We report a study focusing on MMR from different bibliometric perspectives to fill this gap in the current bibliometric studies in AL. In the following sections, we discuss various aspects of the study.

2.1 Purpose of the Study

The purpose of the study reported in this chapter was to conduct a bibliometric analysis of the mixed methods research (MMR) in 18 prominent AL journals. MMR has risen in AL in the last two decades, following a similar trend in other disciplines. We were able to retrieve 256 MMR articles from the 18 journals. It is thus timely to conduct a bibliometric analysis of the scholarly sources in AL that have used or discussed MMR. The following research questions guided our study.

1. What is the publication trend and citation regarding MMR in AL?
2. What are the bibliometric trends in published MMR studies in AL journals?
3. What is the profile of the institutions and countries in MMR-published articles?
4. Which articles are the most cited in MMR articles?
5. What is the network map and density view of the most cited sources in MMR studies?

3 Methodology

3.1 Database Selection

To build the sample of MMR studies for this chapter, WoS was selected as our main database. There are other databases, such as Scopus and Google Scholar. However, for the reasons we discussed in the Introduction Section of the paper, we preferred WoS over Scopus and Google Scholar, given its comprehensiveness.

3.2 Journal Selection and Study Retrieval

We selected 18 leading journals in the field (see Table 1 for the complete list). Culling these scholarly venues was based on some criteria. First, the list represented

Table 1 The sampled journals for bibliometric analysis

Applied linguistics	Language teaching
Assessing Writing	Language Teaching Research
Computer-Assisted Language Learning	Modern Language Journal
ELT Journal	RECALL
Foreign Language Annals	Second Language Research
Journal of English for Academic Purposes	Studies in Second Language Acquisition
Journal of Second Language Writing	Studies in Second Language Learning and Teaching
Language Learning	System
Language Learning & Technology	TESOL Quarterly

journals that have been publishing articles with a wide range of methodological orientations (i.e., pure qualitative, pure quantitative, and mixed methods) and covering different areas of L2 research (i.e., ranging from English for academic purposes to identity and also motivation or anxiety). Secondly, all these journals have been indexed in the Social Sciences Citation Index (SSCI) and have an impact factor above .25 (see Lei and Liu 2019a, b for sampling scheme of L2 journals). We also considered other criteria (e.g., rejection rate, length of publication, availability/accessibility, and experts' opinions) and recommendations proposed for identifying quality (e.g., Egbert 2007) and top-tier journals (see Alise and Teddlie 2010) for selecting the targeted journals. We, for good measure, examined lists of journals on different L2 research syntheses (e.g., Amini Farsani et al. 2021; Plonsky and Gass 2011; Plonsky 2013, 2014; Plonsky and Kim 2016; Plonsky and Ghanbar 2018) to ensure the selected journals are representing the field.

Once the journals were selected, we chose MMR studies published in those journals. In line with Riazi et al. (2018) and Riazi et al. (2020), we selected only pure MMR studies, those that had explicitly framed themselves as MMR. We used the search parameter of (mixed-method*) OR (mixed method*) for searching in the WoS using the timeframe of 1984–2022 (the earliest date that could be available and searched in WoS was 1984). We searched thoroughly in titles, abstracts, keywords, and full texts. Having searched the database, we meticulously reviewed the retrieved studies, as a number of them mentioned our search parameters merely in their keywords, titles, or abstracts without technically framing themselves as MMR. That is, there was no lucid mention in those studies that demonstrated that they exploited MMR methodology and/or cited relevant MMR literature on how the two methodologies were mixed and used to answer their research questions (e.g., Greene et al.'s (1989) classification of purposes for which MMR researchers mixed quantitative and qualitative data and analysis). Hence, these studies were excluded from our corpus.

Eventually, we came up with 256 pure MMR studies in those 18 L2 journals, with the first MMR study being identified in 2008. Interestingly, this number of MMR studies was in line with what was reported in previous reviews of MMR studies in similar top-tier journals in AL and confirmed their reported numbers, suggesting the lack of definitive MMR studies in the field (see, e.g., Riazi et al. 2018; 2020; Riazi, Ghanbar, Marefat, and Fazel, in press). For this study, we just considered full-length articles; hence, other types of publications, such as book reviews, were left out. Having gleaned 256 MMR studies, we retrieved pertaining information, encompassing titles, authors, affiliations, abstracts, and references from WoS and saved it as a text file. Data cleaning was also implemented concerning authors' names, given that some studies used different names to refer to the same author. For instance, "Creswell J W," "Creswell J," "John W. Creswell," and "Creswell J" refer to the same scholar, and we converted them all into "Creswell, J W".

3.3 Data Analysis

We conducted bibliometric analysis in two phases: (a) citation analysis of the impact and (b) co-citation analysis. For the first part of the analysis, mapping the publication trends of MMR studies and citation analysis of the impact, we used Histcite (Barreiro 2015). For the second part, co-citation analysis, we exploited VOS viewer (van Eck and Waltman 2017). More specifically, in the first phase of analysis, Histcite provided information about the yearly publication of MMR studies and total global citation counts of them in each year (TGCS) (i.e., the number of times MMR articles have been cited by other articles indexed in WOS in each year) as well as total local citation counts (TLCS) (i.e., the number of times pure MMR articles have been cited by other pure MMR articles indexed in WoS in each year that were comprising the corpus of this study). In addition, we analyzed the frequency counts of MMR studies in those 18 journals along with their TLCS, TLCS/t (total local citation of MMR studies annually), TGCS, and TGCS/t (total global citation counts of MMR studies annually). Additionally, the number of MMR articles published by various educational institutions and in different geographical regions were examined along with the TLCS and TGCS of those MMR studies in each institution and country. Ultimately, in this phase, we identified the most cited MMR in terms of their LCS, LCS/t, and GCS.

The second phase of data analysis was co-citation analysis. In this scientometric analysis of MMR studies, we chose two types of co-citation analysis: (a) document co-citation analysis (DCA) (see Trujillo and Long 2018) and (b) author co-citation analysis (ACA) (see Wang et al. 2018). In the former, which is based on the frequency of jointly cited references in MMR studies, we investigated how most cited references in MMR studies were connected, and, through this, we extracted several clusters of studies, each having its theme. These themes will help decipher the intellectual structure of MMR studies published in the field and the key literature in these studies. In the latter, ACA, we shed light on how most cited authors in MMR studies connected by citing each other. Similar to DCA, here in this part, several clusters of authors were extracted using a VOS viewer. As Bazerman (1988) mentioned, these clusters represent the "codified network of the literature" (p. 139). Put differently, these patterns of co-cited authors depicted the knowledge structure of MMR studies in the field, given that they are considered influential MMR authors (Zhao and Strotmann 2015).

4 Results

4.1 Publication Trends and Citation

The first section of the results presents the publication trend of MMR studies in 18 key journals in the field. The overall trend of MMR studies in the field is upward,

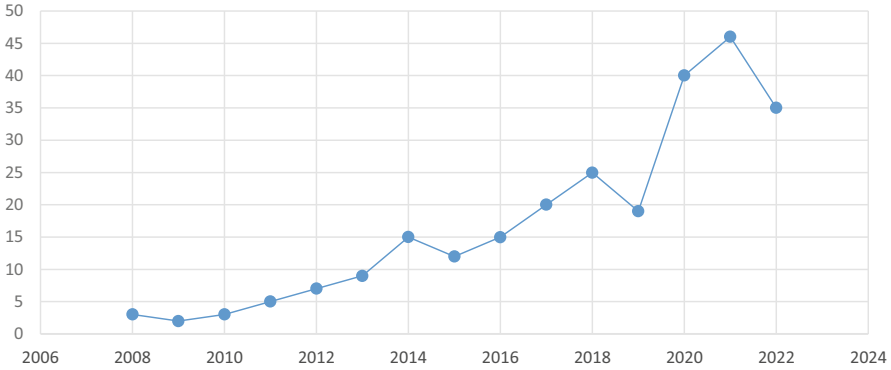

Fig. 1 Yearly publication of MMR studies

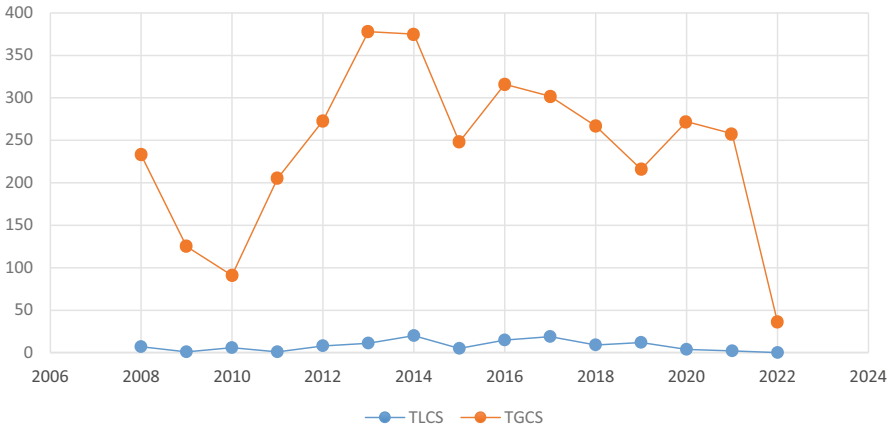

Fig. 2 Yearly TLCS and TGCS of MMR studies

with a peak in 2021, despite some fluctuations. As can be seen in Fig. 1, the first explicitly stated MMR studies appeared in 2008. Two articles (Caldas 2008; Derwing et al. 2008) were published in *Applied Linguistics* (AL) and one (Ranalli 2008) in *Computer Assisted Language Learning* (CALL). These three articles, in total, had a TGCS of 253, which, compared to the number of published MMR studies in other years like 2016 or 2018, as well as their frequencies, can be considered highly-cited studies.

Pertaining to the trend of TLCS and TGCS across the period of 2008–2022, it can be seen in Fig. 2 that the former measure followed a very smooth trajectory, yet the latter showed some wild fluctuations. More specifically, from 2008 to 2010, the TGCS of MMR studies demonstrated a sharp dip, whilst, from 2010 to 2013, it witnessed a dramatic rise in their citations. Nevertheless, despite some fluctuations from 2014 to 2022, we see a steady decrease in the number of citations of these articles.

4.2 Frequency and Citation Analysis of MMR Studies in AL Journals

As can be seen in Fig. 3 and Table 2, the *System* published most MMR papers (n = 45, 18%), followed by CALL (n = 32, 13%) and *Language Teaching Research* (LTR) (n = 25, 10%) (See Table 2 for other outlets and the bibliometric information of their published MMR studies). Regarding TGCS of MMR studies published in L2 journals, MMR articles have been cited 3595 times in aggregate. To discuss it in more detail, we can say that MMR studies in CALL have received the highest number of citations, suggesting that MMR research has been found to have a superior functionality for the research theme of CALL in AL. It is intriguing that despite the fact that *Modern Language Journal* (MLJ) and *TESOL Quarterly* both published a few MMR studies (n = 14), they got 366 and 311 cations, respectively, which are far more than that of MMR studies published in other journals with a higher frequency of MMR articles (e.g., *Assessing Writing, Foreign Language Annals, RECALL*).

4.3 Institutions and Countries

MMR studies in our sample were conducted at 300 universities (some MMR studies were conducted in more than one institution) within 43 countries. Table 3 presents

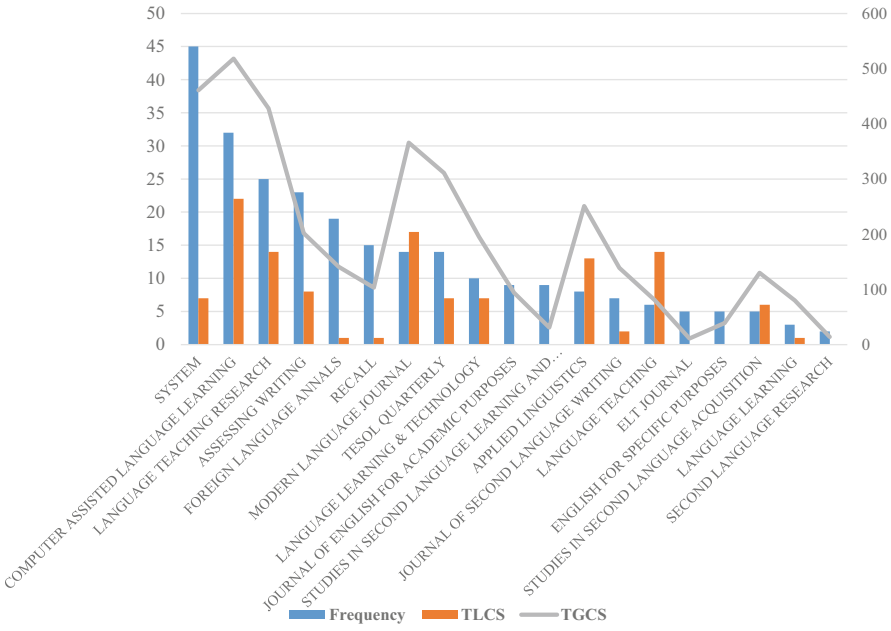

Fig. 3 Bibliometric portrayal of MMR studies published in L2 journals

Table 2 The frequency of MMR studies in journals, along with their bibliometric information

Journal	Frequency (%)	TLCS	TLCS/t	TGCS	TGCS/t
System	45(18%)	7	1	461	118.85
Computer assisted language learning	32(13%)	22	4.62	518	123.75
Language teaching research	25(10%)	14	2.15	428	57.19
Assessing writing	23(9%)	8	1.19	202	35.42
Foreign language annals	19(7%)	1	0.17	141	19.59
RECALL	15(6%)	1	0.17	103	25.21
Modern language journal	14(5%)	17	2.32	366	59.63
TESOL quarterly	14(5%)	7	1.03	311	36.54
Language learning & technology	10(4%)	7	1.11	195	35.21
Studies in second language learning and teaching	9(4%)	0	0	31	9.48
Journal of English for academic purposes	9(4%)	0	0	94	22.81
Applied linguistics	8(3%)	13	1.27	251	26.66
Journal of Second Language Writing	7(3%)	2	0.31	139	19.98
Language teaching	6(2%)	14	1.59	81	9.93
Studies in second language acquisition	5(2%)	6	1.18	130	17.42
English for specific purposes	5(2%)	0	0	39	6.39
ELT journal	5(2%)	0	0	11	4.87
Language learning	3(1%)	1	0.09	80	8.8
Second language research	2(1%)	0	0	14	4.67
Total	**256(100%)**	**120**	**18.2**	**3595**	**642.4**

Table 3 Bibliometric information of MMR studies of the most productive universities

Institution	Frequency (%)	TLCS	TGCS
Lancaster Univ	9(14.5%)	7	118
Macquarie Univ	8(12.9%)	19	171
Iowa State Univ	7(11.3%)	6	303
Chinese Univ Hong Kong	6(9.7%)	0	48
Michigan State Univ	6(9.7%)	1	33
Concordia Univ	5(8.1%)	5	158
McGill Univ	5(8.1%)	5	163
Brigham Young Univ	4(6.5%)	0	35
Georgetown Univ	4(6.5%)	2	41
Hong Kong Polytech Univ	4(6.5%)	0	28
Razi Univ	4(6.5%)	13	106

the bibliometric information of the top 10 universities where the MMR studies were implemented. As can be viewed in Table 3, the *University of Lancaster*, *Macquarie University,* and *Iowa State University* are the three top venues. Nonetheless, a different picture emerged regarding the TGCS of MMR studies. Despite the fact that *Iowa State University* was ranked 3rd, considering the number of published

Table 4 Bibliometric information of geographical regions of MMR studies

Country	Frequency (%)	TLCS	TGCS
USA	87(29.7%)	32	1190
UK	39(13.3%)	13	714
China	29(9.9%)	1	290
Iran	19(6.5%)	22	308
Australian	16(5.5%)	19	286
Canada	16(5.5%)	17	510
Japan	13(4.4%)	5	131
Germany	9(3.1%)	5	143
South Korea	8(2.7%)	8	89
Spain	8(2.7%)	0	26
Netherlands	6(2%)	4	69
Saudi Arabia	6(2%)	0	37
Turkey	6(2%)	1	92
Taiwan	5(1.7%)	1	24
Unknown	5(1.7%)	3	166
Vietnam	5(1.7%)	0	20
Austria	4(1.4%)	0	40
Chile	4(1.4%)	4	95
Hungary	4(1.4%)	1	8
Ireland	4(1.4%)	0	32

MMR studies, they had the highest number of citations regarding the entire WoS count at the time of our data collection. The next is *Macquarie University and McGill University* (see Table 2 for exact TGCSs). Although *McGill University and Concordia University ranked* 6th *and* 7th in terms of the frequency of MMR studies, they are on top of the ladder pertaining to the citations of their published MMR studies.

Considering the geographical regions, as can be seen in Table 4, authors from the USA published about one-third of MMR studies, and, in turn, these articles got the largest number of citations (n = 87, 29.7%, TGCS = 1190), followed by UK (n = 39, 13.3%, TGCS = 714) and China (n = 29, 9.9%, TGSC = 290). Interestingly, notwithstanding that Iran was ranked lower than China in terms of published MMR studies, its works achieved more citations than those from China. Another intriguing example is Canada, with 16 MMR studies (5.5%), yet with a TGCS of 510, much higher than that of China, which was ranked 3rd in terms of the productivity of MMR studies (n = 29, 9.9%, TGSC = 290).

4.4 The Most Cited MMR Studies

Table 5 presents the ten most cited MMR studies. As can be seen, Derwing et al. (2008), a study on learners' fluency and comprehensibility development, published

in AL, with a TGCS of 118, is the most cited MMR study. Ranalli (2008), in CALL (targeting simulation games for L2 learning), and Isaacs and Trofimovich (2012), published in *Studies in Second Language Acquisition* (about listeners' L2 comprehensibility ratings), are ranked second and third, with TGCS of 106 and 99, respectively. It should be mentioned that TGCS/t (the annual citation counts of articles in 1 year) revealed that Greenier et al. 2021 (with a focus on emotion regulation and psychological well-being of teachers), published in *System*, has got the highest yearly total global citation (TGCS/t = 37.5), followed by Li et al. (2015) (with a focus on automated writing evaluation), published in the *Journal of Second Language Writing* (TGCS/t = 9.38) and Isaacs and Trofimovich (2012) (with a focus on listeners' L2 comprehensibility ratings) (TGCS/t = 9.00).

Table 5 The most cited MMR studies

Articles	LCS	LCS/t	TGCS
Derwing, TM., & Munro, MJ., & Thomson, RI. (2008). A longitudinal study of ESL learners' fluency and comprehensibility development. Applied Linguistics.	4	0.27	118
Ranalli, J. (2008). Learning English with the sims: exploiting authentic computer simulation games for L2 learning. Computer-Assisted Language Learning.	2	0.13	106
Isaacs, T., & Trofimovich, P. (2012). Identifying the linguistic influences on listeners' L2 comprehensibility ratings. Studies in Second Language Acquisition.	2	0.18	99
Tan, M. (2011). Mathematics and science teachers' beliefs and practices regarding the teaching of language in content learning. Language Teaching Research.	1	0.08	94
Busse, V., & Walter, C. (2013). Foreign language learning motivation in higher education: A longitudinal study of motivational changes and their causes. Modern Language Journal.	2	0.20	84
Hamid, MO., & Sussex, R., & Khan, A. (2009). Private tutoring in English for secondary school students in Bangladesh. TESOL Quarterly.	0	0.00	81
Riazi, AM., & Candlin, CN. (2014). Mixed-methods research in language teaching and learning: Opportunities, issues, and challenges. Language Teaching.	13	1.44	76
Li, JR., & Link, S., & Hegelheimer, V. (2015). Rethinking the role of automated writing evaluation (AWE) feedback in ESL writing instruction. Journal Of Second Language Writing.	0	0.00	75
Greenier, V., & Derakhshan, A., & Fathi, J. (2021). Emotion regulation and psychological well-being in teacher work engagement: A case of British and Iranian English language teachers. System	0	0.00	75
Ferris, DR. (2014). Responding to student writing: Teachers' philosophies and practices. Assessing Writing.	1	0.11	73

4.5 *Co-citation Analysis: The Network Map and Density View of the Most Cited References*

The sampled articles in our corpus cited 11,504 references. As MMR studies continue to emerge in our field (see Riazi et al. in press), we set a minimum number of 7 as a highly-cited reference (it should be cited at least seven times to be considered a frequently cited source as this threshold yielded enough number of articles for us to further investigate, that is, top 37 most-cited references). This resulted in a retrieval of 37 sources, which met this threshold criterion. As can be seen in Fig. 4, utilizing "association strength" (see Van Eck and Waltman 2017) as the normalization technique led to extracting four clusters from within those 37 garnered studies. Table 6 also presents the internal structure of each cluster. The first cluster, the biggest one, represented a cognitive and psychological perspective on second language learning, comprising sources such as Dornyei (2005, 2007, 2009) as well as Dörnyei and Ushioda (2011), which can be roughly placed in the psychological category, and also Tseng et al. 2006, which would be considered in the cognitive category. The second cluster, the second biggest one, named "MMR methodological issues and cognitive approaches to second language learning with a focus on implicit learning mechanisms," showcased sources such as Braun and

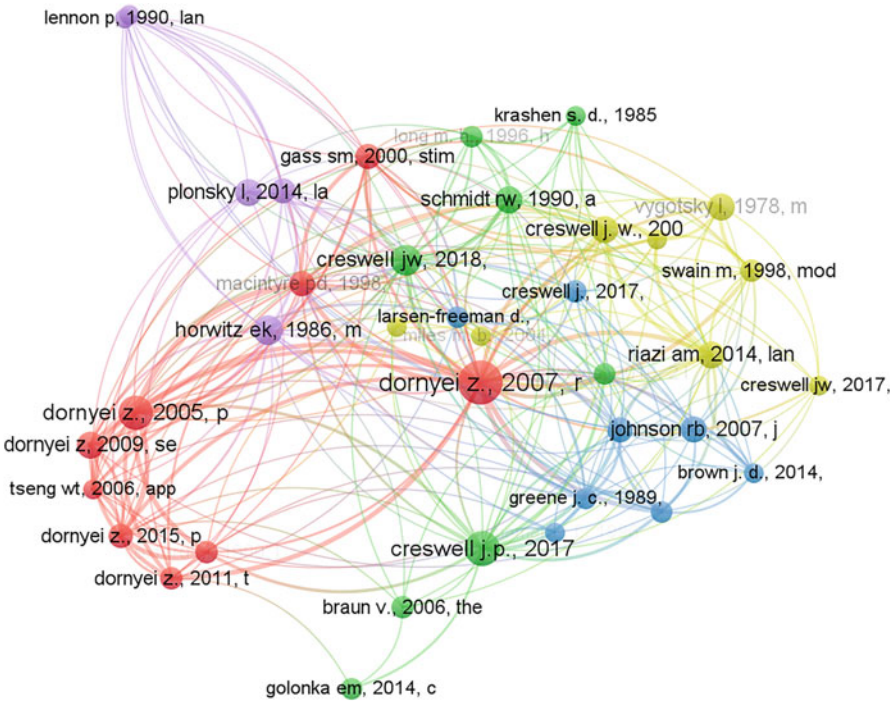

Fig. 4 Network visualization map of the most cited references

Table 6 The clusters of the most cited references

Cluster 1 (Cognitive and Psychological Perspective on Second Language Learning)
Dornyei, Z. (2009). The Psychology of Second Language Acquisition-Oxford Applied Linguistics. Oxford University Press.
Dornyei, Z. (2007). Research methods in applied linguistics.
Dornyei, Z. (2005). The psychology of the language learner: Individual differences in second language acquisition. New Jersey: Mahwah
Dornyei, Z. and Ushioda, E. (2011) Teaching and Researching Motivation. 2nd Edition, Pearson, Harlow.
Dornyei, Z., & Ryan, S. (2015). The psychology of the language learner revisited. Routledge.
Gass, S. M., & Mackey, A. (2000). Stimulated recall methodology in second language research. Lawrence Erlbaum Associates Publishers.
MacIntyre, P. D., Clément, R., Dörnyei, Z., & Noels, K. A. (1998). Conceptualizing willingness to communicate in an L2: A situational model of L2 confidence and affiliation. The Modern Language Journal, 82(4), 545–562.
Tseng, W. T., Dörnyei, Z., & Schmitt, N. (2006). A new approach to assessing strategic learning: The case of self-regulation in vocabulary acquisition. Applied linguistics, 27(1), 78–102.
Oxford, R. (1990). Language Learning Strategies: What Every Teacher Should Know. New York: Newbury House Publishers.
Cluster 2 (MMR Methodological Issues and Cognitive Approaches to Second Language Learning with a Focus on Implicit Learning Mechanisms)
Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77–101.
Creswell. J. W. and Creswell, J. D. (2017) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th Edition, Sage, Newbury Park.
Creswell, J. W., & Clark, V. L. P. (2018). Designing and conducting mixed methods research. Sage publications.
Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. Computer-Assisted Language Learning, 27(1), 70–105.
Krashen, S. (1985). The input hypothesis: Issues and implications. New York: Longman.
Long, M. H. (1996). The role of the linguistic environment in second language acquisition. In W. C. Ritchie, & T. K. Bhatia (Eds.), Handbook of second language acquisition (pp. 413–468). New York: Academic Press.
Mackey, A., & Gass, S. M. (2016). Second language research: Methodology and design. Routledge.
Schmidt, R. W. (1990). The role of consciousness in second language learning. Applied linguistics, 11(2), 129–158.
Cluster 3 (MMR Methodology and Language Assessment)
Brown, J. D. (2014). Mixed methods research for TESOL. Edinburgh, Scotland: Edinburgh University Press.
Creswell. J. W. and Creswell, J. D. (2017) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th Edition, Sage, Newbury Park.
Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. Educational Evaluation & Policy Analysis, 11, 255–274.
Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. Educational researcher, 33(7), 14–26.
Johnson, R.B., Onwuegbuzie, A.J. and Turner, L.A. (2007) Toward a Definition of Mixed Methods Research. Journal of Mixed Methods Research, 1, 112–133.

(continued)

Table 6 (continued)

Larsen-Freeman, D., & Cameron, L. (2008). Complex systems and applied linguistics (p. 287p). Oxford: Oxford University Press.
Mac Namara, T. (1996). Measuring second language performance, Applied linguistics, and language study.
Teddlie, C. and Tashakkori, A. (2009) Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences. Sage, London.
Cluster 4 (Qualitative Data Analysis, MMR, and Social-Interaction Research)
Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Sage.
Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed.). Thousand Oaks, CA: Sage.
Creswell. J. W. and Creswell, J. D. (2017) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th Edition, Sage, Newbury Park.
Miles, M. B., Huberman, A. M., & Saldaña, J. (2004). Qualitative data analysis: A methods sourcebook. Sage publications.
Riazi, A. M., & Candlin, C. N. (2014). Mixed-methods research in language teaching and learning: Opportunities, issues and challenges. Language teaching, 47(2), 135–173
Schmidt, R. (2001). Attention. In P. Robinson (Ed.), Cognition and Second Language Instruction (pp. 3–32). Cambridge: Cambridge University Press.
Swain, M., & Lapkin, S. (1998). Interaction and second language learning: Two adolescent French immersion students working together. The Modern Language Journal, 82(3), 320–337.
Vygotsky, L. S., & Cole, M. (1978). Mind in society: Development of higher psychological processes. Harvard University Press.
Cluster 5 (MMR and Quantitative data analysis)
Cohen, J. (1988). Statistical power analysis for the behavioral sciences. Lawrence Erlbaum Associates.
Horwitz, E. K., Horwitz, M. B., & Cope, J. (1986). Foreign language classroom anxiety. The Modern Language Journal, 70(2), 125–132.
Lennon, P. (1990). Investigating fluency in EFL: A quantitative approach. Language learning, 40(3), 387–417
Plonsky, L., & Oswald, F. L. (2014). How big is "big"? Interpreting effect sizes in L2 research. Language learning, 64(4), 878–912.

Clarke (2006), Creswell and David Creswell (2017), and Krashen (1985). (see also Fig. 5 as a heat map of the most cited references and Table 6 for the internal structure of other clusters).

4.6 Co-citation Analysis: The Network Map and Density View of the Most Cited Authors

Table 7 depicts the list of top-cited authors in MMR studies, and, as can be seen, the most cited authors were Zoltán Dörnyei, John W. Creswell, Peter MacIntyre, Rod Ellis and Ken Hyland.

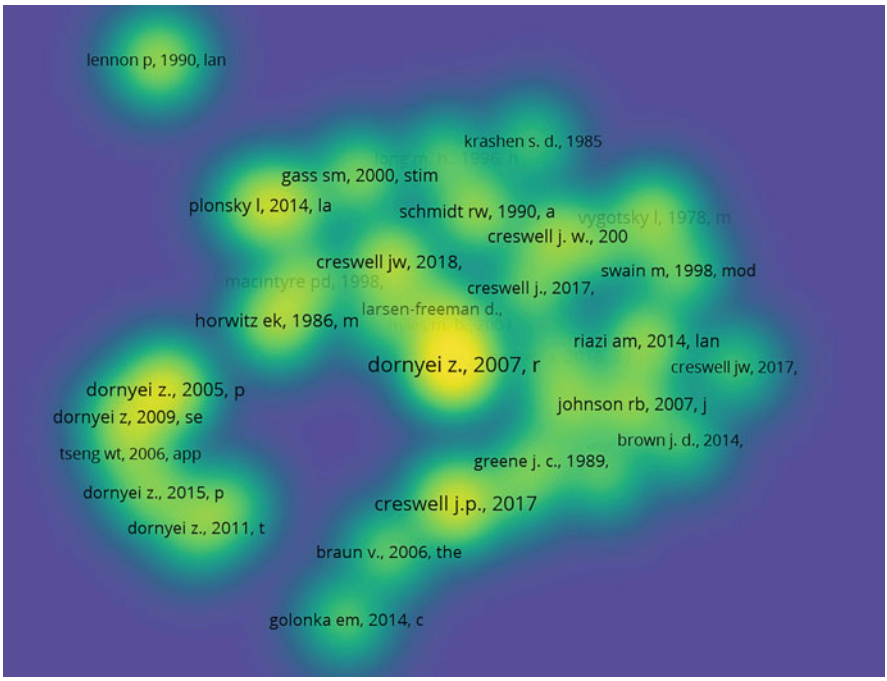

Fig. 5 The heat map of the most cited references

Additionally, the bibliometric analysis of the most cited authors in terms of co-citation analysis using "association strength" (see Van Eck & Waltman 2017) as the normalization technique culminated in identifying five clusters from within the 45 most-cited authors (see Table 8 and Fig. 6). It should be mentioned that those 45 most-cited authors had to receive at least 20 citations in the corpus of MMR studies to be considered highly-cited authors in our analysis (see Fig. 6 and Fig. 7).

The network map illustrated (see Fig. 6, Fig. 7, and Table 8) that cluster one, the biggest cluster, the research methodology and assessment cluster, included scholars such as Khaled Barkaoui, James Dean Brown, and John W. Creswell. Next, cluster two, which can be named as cognitive aspects of language acquisition (e.g., individual differences represented by Peter Macintyre and Elaine Horwitz), was mainly represented by scholars such as Albert Bandura, Andrew Cohen, Zoltan Dornyei and Kata Csizér. The third cluster, the interaction research cluster, was composed of authors like Rod Ellis, Susan Gass, and Michael Long. The writing cluster was our fourth cluster, and scholars who showcased this cluster were John Bitchener, Dana Ferris, and Ken Hyland, to name some. The last cluster is a task-based language learning and teaching cluster with the presence of Judit Kormos, Peter Robinson, and Peter Skehan.

Table 7 Top-cited authors in MMR studies

Author	Citations	Author	Citations
Dornyei, z	168	Ferris, D	25
Creswell, J W	114	Gardner, R C	25
Macintyre, P D	66	Ortega, L	25
Ellis, R	65	Derwing, T M	25
Hyland, K	58	Zimmerman, B J	24
Dewaele, J M	44	Johnson, R B	24
Long, M H	44	Lee, I	23
Swain, M	44	Csizer, K	23
Schmidt, R W	42	Ushioda, E	23
Plonsky, L	42	Vygotsky, L	23
Kormos, J	37	Brown, J D	22
Horwitz, E K	37	Kessler, G	22
Oxford, R L	33	Robinson, P	21
Mackey, A	31	Tashakkori, A	21
Ferris, D R	30	Larsen-freeman, D	21
Cumming, A	30	Macaro, E	21
Skehan, P	29	Bandura, A	20
Pawlak, M	28	Chapelle, C A	20
Gass, S M	28	Truscott, J	19
Storch, N	27	Polio, C	19
Barkaoui, K	27	Cohen, J	19
Bitchener, J	26	Teddlie, C	19
Cohen, A D	26	Riazi, A M	19

5 Discussion

5.1 Publication trends

In this study, we set out to have a bibliometric view of MMR studies in the field. Regarding the publication trends, we found that MMR studies have been growing in the field. Yet, when comparing the results with other reviews in the field, like Amini Farsani et al. (2021) or Hashemi and Babaii (2013), we saw fewer MMR studies, which can be attributable to our definition of a typical MMR study. In line with Riazi (2016) and Riazi et al. (2018), merely having qualitative and quantitative data and analysis in one study would not make it MMR. To be considered an MMR, as we mentioned in the methodology section, studies need to explicitly mention that they exploited MMR methodology and cite relevant MMR texts and literature that discuss different aspects of MMR, sources like Greene et al. (1989) or Riazi and Candlin (2014). In fact, in the interest of transparency, MMR researchers should rely on such sources to explain how they mix the two methodologies and which MMR design they adhere to. Our preliminary results shed light on the fact that many studies did not adhere to this standard, so they could not be considered eligible for such a bibliometric study. In tandem, intriguingly, explicit MMR studies in the field

Table 8 Clusters of the most cited authors in MMR studies

Cluster1(15 items)	Macintyre, P D
Barkaoui, K	Oxford, R L
Brown, J D	Pawlak, M
Chapelle, C A	Ushioda, E
Creswell, J W	Zimmerman, B J
Cumming, A	**Cluster3(7 items)**
Derwing, T M	Ellis, R
Johnson, R B	Gass, S M
Kessler, G	Long, M H
Larsen-freeman, D	Mackey, A
Ortega, L	Schmidt, R W
Plonsky, L	Swain, M
Polio, C	Vygotsky, L
Riazi, A M	**Cluster4 (6 items)**
Tashakkori, A	Bitchener, J
Teddlie, C	Ferris, D R
Cluster2 (13 items)	Hyland, k
Bandura, A	Lee, I
Cohen, A D	Storch, N
Csizer, K	Truscott, J
Dewaele, J M	**Cluster5(3 items)**
Dornyei, Z	Kormos, J
Gardner, R C	Robinson, P
Horwitz, E K	Skehan, P
Macaro, E	

appeared in 2008 and then followed an explicit upward trend in the field, which has been illustrating the rising methodological transparency and rigor in the field pertaining to MMR studies, echoing what was found in other review studies (e.g., Riazi et al. 2018; Riazi et al. 2020; Riazi et al. in press). This may be partly attributed to several state-of-the-art articles in the field striving to boost the methodological rigor of MMR (see, e.g., Riazi 2016; Riazi and Candlin 2014). We here mention this pivotal point that explicit MMR studies would also get a higher number of global citations compared to inexplicit MMR studies as it is highly likely that they appear in searches and sampling of other systematic reviews and bibliometric studies. This is mainly because of their methodological transparency, resulting in these studies being showcased and used by prospective scholars. What is more, the observed upswing in the number of pure MMR studies can be an indication of MMR popularity and versatility for investigating new topics like computer simulation games for L2 learning and longitudinal studies of ESL learners' fluency and comprehensibility development. However, the fluctuations and even a lower global citation count of the most recent pure MMR studies in comparison with those of what we observed before 2010 is, in a way, substantiated by the fact that a typical study needs a few years (see Lei and Liu 2019b for a related discussion) before receiving a thriving number of

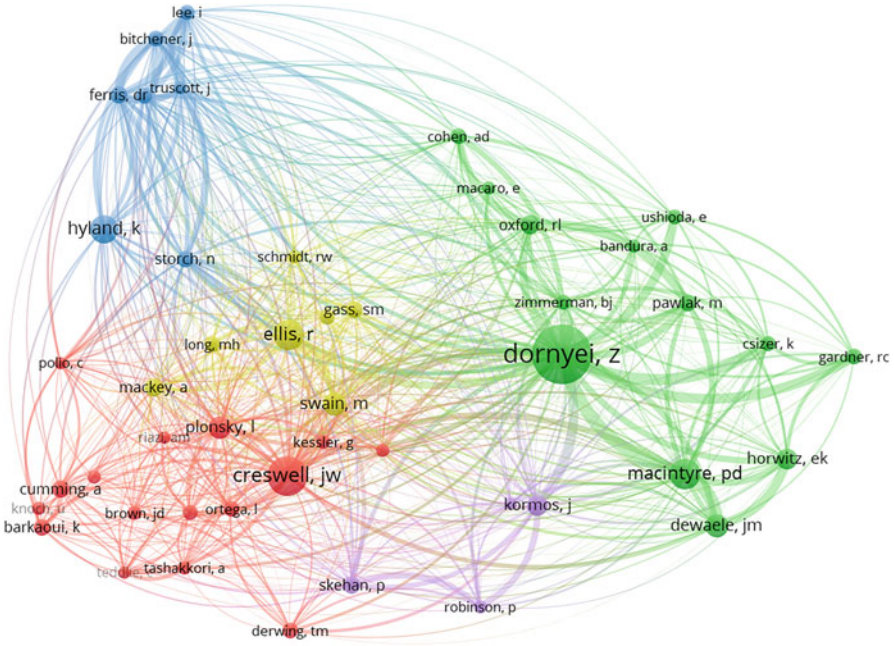

Fig. 6 The co-citation analysis of the most cited authors in MMR studies

citations. Hence, we can predict that these studies will gain more recognition from other studies in the field in the foreseeable future.

5.2 *Bibliometric Analysis of Published MMR Studies in L2 Journals*

We also found that *System* published the highest number of MMR studies. This can be substantiated by the fact that System has been publishing remarkably more papers than other journals, with eight volumes each year, twice as many as other journals like *Journal of Second Language Writing* or MLJ. This might be related to this journal's editorial policies that aim to publish articles from a wider range of topics (see also Lei and Liu 2019a). Compared with other journals like the *Journal of Second Language Writing* or *English for Academic Purposes* that have limited scopes, the variety of topics in System lend themselves better to various methods, including MMR. Additionally, the high number of MMR studies in *System* might illustrate MMR methodological transparency and the journal's first rank in WoS regarding MMR. Nonetheless, as our results revealed, in line with Bazerman (1988) and Hyland and Jiang (2019), no relationship can be considered between the number of published MMR studies in the journal and their TGCS. A case in point is CALL,

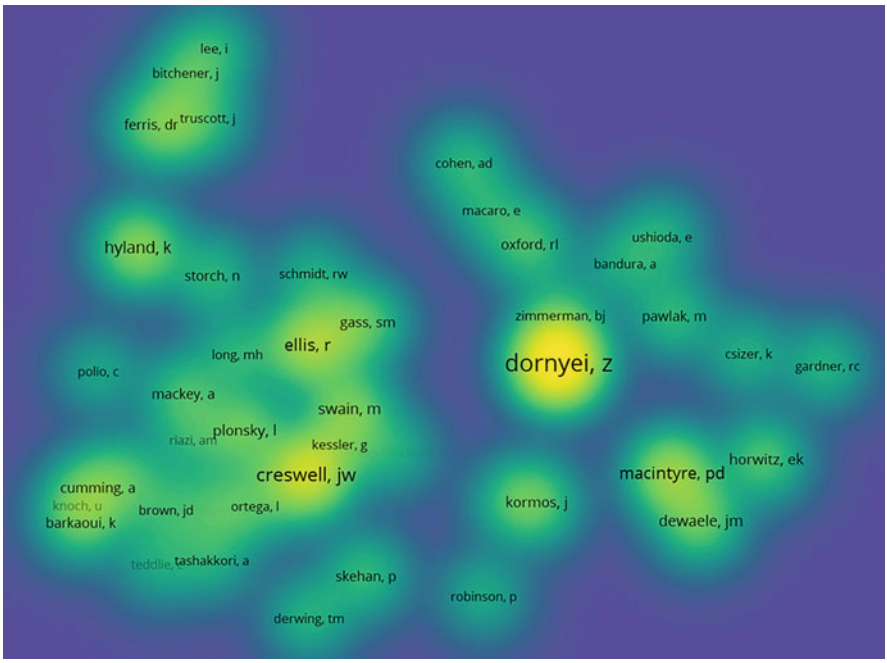

Fig. 7 Density visualization of the most-cited authors

which, despite having fewer MMR articles than *System*, has a higher TGSC. This might also suggest that MMR lends itself better to topics and issues in CALL (CALL has been ranked 2nd in publishing MMR), as we also see that RECALL has been ranked 6th in publishing MMR studies. The same can be said for *Assessing writing* (ranked 4th in publishing MMR), which implies a potential link between the use of MMR methods (sub)disciplines.

Another example is MLJ, with a quarter of MMR articles compared to *System*. Yet, the citation rates were slightly fewer than those of *System*. Given that TGCS is an indication of the academic impact and interdisciplinary rigor of articles published by a journal (Alon et al. 2018), it can be argued that, in many cases, this measure is not proportionate to the number of articles published by the journal.

Relating to TLCS, that is, the number of times a typical pure MMR study is cited by other pure MMR studies in our sample in WoS, it can be seen that MMR studies published in CALL received the highest recognition in comparison with MMR studies of other venues. This finding demonstrates that papers in CALL issues, when examined multidimensionally through MMR, came to not only the attention of other studies in WoS journals (see the discussion on TGCS) but also that of our sampled pure MMR articles. Another intriguing point is that despite the fact that MMR articles of *System* were ranked 2nd in terms of TGCS, they were not receiving ample local citations, a point suggesting no association between TGCS and TLCS, which is corroborated when we consider TLCS of other venues such as MLJ,

Language Teaching, or AL. This point alludes to a potential link between a journal's impact factor (IF) (also its prestige) and TLCS. In fact, pure MMR studies in our sample have been more inclined to cite other pure MMR studies that have been published in highly prestigious journals with high IFs (more than 6), such as MLJ (5-year IF of 7.98), AL (5-year IF of 6.17), and *Language Teaching* (5-year IF of 6.02), though sub-discipline may slightly moderate this correlation in some cases such as CALL (5-year IF of 5.93).

5.3 Institutions and Countries

The same trend was observed regarding institutions contributing to MMR studies. In contrast to Zhang's (2020) findings, North American universities were not dominant; rather, *Lancaster* in Europe and *Macquarie* in Oceanian were at the top ranks. When it comes to TGCS, however, most North American universities like *Iowa State, McGill,* and *Concordia* got the highest number of citations. Interestingly, *Razi University of Kermanshah* in Iran also received many citations for the MMR studies from this institution. This is while its record of MMR studies is half of those published by North American or European universities. This also resonates with what Lei and Liu (2019b) observed, that countries like Iran or China have started to make a substantial contribution to the field of Applied Linguistics, which is also reflected in the number of MMR studies.

5.4 The Most Cited MMR Studies

The results in this part brought to the fore the most frequently cited MMR articles. Our findings illustrated that the most cited MMR studies targeted a wide range of topics, from L2 comprehension to teacher education and CALL. As we move ahead, most of the topics in AL lend themselves to MMR. This is because AL and L2 researchers are now addressing more complex and multidimensional research problems. The complexity and multidimensional nature of the research problems demands collecting and analyzing both quantitative and qualitative data and making more comprehensive conclusions. However, some sub-disciplines like L2 reading and writing, teacher education, and CALL have initiated using MMR, as shown by our findings. On the other hand, and considering the point raised by Lei and Liu (2019b) that it took an average of 4 years for a publication to reach its peak citation, we can say that teacher education and L2 writing, and comprehension have been becoming hot topics in recent MMR studies in the field. This finding is in contrast with what Lei and Liu (2019b) and Lei and Liu (2019a) reported, which is, in a way, expected, given that those studies were not bibliometric studies on a specific research methodology. In fact, the former was a bibliometric study on the field of Applied Linguistics in general, and the latter was a journal-based scientometric study. This

result supports the claim that it is time in scientometric Applied Linguistics research to focus specifically on different research methodologies and not a field in general.

5.5 Co-citation Analysis of Most Cited References

The clusters of high-cited sources in MMR studies brought to the fore several issues about emerging themes in this line of research. Firstly, we witnessed that, generally, the cognitive perspective in SLA was popular in MMR studies, and, specifically, articles on topics such as motivation and language learning strategies were pervasive. This way, it is evident that cognitive perspective, while being a dominant theme, lends itself to MMR methodology. This finding is also in line with the most recent bibliometric studies in SLA (e.g., Zhang 2020). It should be mentioned that MMR methodology is very versatile, and using it for examining other complicated research areas like teacher education, sociocultural perspective and even genre analysis can lead to more comprehensive results. Of note is the cluster related to MMR methodological issues, which lucidly illustrated the methodological rigor and transparency in MMR studies retrieved in WoS. As we discussed before, elaborating on MMR literature and elucidating the rationale behind mixing data collection and analysis would boost the methodological rigor of MMR studies and enhance their visibility in different databases such as WoS and Scopus.

Identifying a clear purpose for mixing quantitative and qualitative data and analysis will give direction to the design and implementation of MMR studies. It will thus enhance MMR studies and their visibility when they explicitly state a purpose for mixing quantitative and qualitative methods.

5.6 Co-citation Analysis of Most Cited Authors

The top-cited authors based on our analysis were Zoltan Dornyei, John W. Creswell, Peter MacIntyre, and Rod Ellis. In a way, this finding confirmed what we found in the co-citation analysis of most cited references. As it was illustrated, Zoltan Dornyei was the most cited author in MMR studies, which was a result of the dominance of cognitive and psychological issues in MMR studies, and it was further substantiated with cited works such as Dornyei (2005, 2009), Dörnyei and Ushioda (2011) as well as Dornyei and Ryan (2015). This finding resonates with what Lei and Liu (2019b) and Zhang (2020) presented in their bibliometric studies. The second most cited author was John W. Creswell, again pointing to the influential role of research methodology sources in MMR studies, such as Creswell (2003) and Creswell and David Creswell (2017). Generally, as can also be seen in the network map and density visualization of authors, Zoltan Dornyei and John W. Creswell are the most influential figures in MMR studies. Regarding the patterns of the most cited authors, as shown in our network map, the biggest cluster was related to research

methodology and assessment issues. This might be due to the fact that MMR authors tried to substantiate their utilization of different research methods and evaluation techniques by connecting them to key scholars in the field. The second biggest cluster was the cognitive and psycholinguistics cluster, which was in line with the cognitive dominance of the most cited references in MMR studies. Furthermore, the presence of figures like Rod Ellis, Susan Gass, and Michael Long was a clear representation of MMR in interaction research. The first two clusters and their closeness sheds light on the dominance of MMR in cognitive-interactionist SLA. This convergence is in line with what Mitchell et al. (2019) mentioned as input and interaction in second language learning (c.f. Susan Gass, Merrill Swain, Richard Schmidt), in a way, has not challenged many concepts in the cognitive domain in SLA. With regard to the writing cluster, the presence of John Bitchener, Dana Ferris, and Ken Hyland pointed to an interesting fact that MMR not only a good fit for general writing instruction but also it is functional when it comes to writing in other areas like English for Academic Purposes (EAP) or English for Specific Purposes (ESP), although regarding EAP and ESP our results signified a need for more pure MMR studies, corroborating what Riazi et al. (2020) found in their review on EAP research.

6 Conclusion

In this chapter, we aimed to portray a scientometric picture of MMR studies in AL using citation analysis of impact, document co-citation analysis, and author co-citation analysis. Using citation analysis of impact, we provided a lucid, historical picture regarding the number of true MMR studies in the field, their publication venues, institutions, and nationalities. The results of this part are fruitful for the field, as it manifests which journals have published MMR more than others and also which countries or institutions in the field have played a more active part in this research avenue. TGCS and TLCS reported in this part of the study also showed the scholarly impact of MMR studies published in different publication venues, nations, and academic institutions. This empirically grounded knowledge base, in addition to research manuals, which are, in a way, not evidence-based, would help prospective researchers to grasp principles of best practices in MMR literature, apart from this fact that it can be beneficial for new students who aim to frame their studies in this methodology. Our results, moreover, assist scholars in their submission decisions and in knowing which journals are better choices for publishing their MMR studies.

Also, co-citation analysis in this study partially illuminated the foci of MMR studies as well as how their authors substantiated their methodological choices and decisions. In actuality, the former demonstrated which topics have been investigated more frequently than others and also in which areas we see the paucity of MMR studies, areas like ESP, EAP and sociocultural theory, yet more studies and systematic reviews are necessary to cast more light and portray a detailed picture in this regard. The latter point will also have a pivotal role in boosting the methodological

rigor and transparency of MMR studies in the field because it has shown in what ways and by using which sources MMR authors have taken methodological steps and vindicated their methodological choices.

This study is not devoid of limitations, on no account indeed. First, it focused on 18 journals in the field. Hence, future studies might focus on other journals or delve into a more inclusive list of L2 journals. Additionally, other online databases, like Scopus, could complement the picture we portrayed in this study. Another issue, which is beyond the scope of this study, is shedding light and presenting a detailed picture of MMR studies' research foci. It should be mentioned and reiterated here that finding the main focuses of MMR studies necessitates another study in which more qualitative techniques like what we see in Riazi et al. (2018) or Riazi et al. (2020) may be used. What this study and any bibliometric study we believe can illustrate is just based on a co-citation analysis, which, in our view, cannot provide a full picture of the research themes of MMR studies. Ultimately, and of utmost significance, other methodologies like quantitative and qualitative need to be targeted in future methodological scientometric studies in the field, given the dearth of such studies in AL.

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An Analysis of Writing for Publication Research on Novice Anglophone (L1) Academics: A Scientometric Perspective

Ismaeil Fazel and Pejman Habibie

1 Introduction

The knowledge economy has become an integral and significant component of national and global economies and a strategic means of socio-political dominance or hegemony on a global scale. The boundaries between the knowledge economy and the monetary economy are extensively blurred, which has boosted the marketization of higher education in many international contexts (Flowerdew and Habibie 2021). In the current knowledge economy, knowledge as a traditional cultural capital has been commodified and transformed into a product with exchange value on global markets (Habibie 2022b; Slaughter and Rhoades 2004). An important form in which the produced knowledge is packaged and exchanged is scholarly publication in academic journals. This pivotal status of knowledge economy and commodified knowledge has spurred a fierce competition among higher education institutions to boost their capacity as knowledge factories and consequently raise their ranking in international university leagues. These neoliberal undercurrents have ushered in new measures to evaluate academic productivity, mainly manifested in the form of quantifiable performative criteria such as publication rate and publication-related indices (e.g., impact factors), which bear mounting pressure to publish on academics across academia (Englund and Gerdin 2023; Miller et al. 2011). In this context, everything and everybody, including universities, their staff, journals, knowledge, languages, etc., are commodified, stratified, and marketed. For example, English-

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medium articles published in high-indexed Western journals are ranked higher than non-English ones published in local journals.

Consequently, it remains a fact that knowledge production and mobilization have become the ultimate mission of many international academic institutions. In this context, the policies and practices of those institutions enforced by their strict measures of audit and evaluation (see Welch and Li 2021) force academic staff to serve as knowledge workers. That is, they are required to produce and disseminate as much knowledge as possible to survive, establish, and advance in such a system. This insatiable thirst for the current knowledge regime has put extensive pressure on many international scholars and has made scholarly publication an existential threat for them, especially those in the so-called (semi)periphery for whom English is an additional language (EAL) (Habibie 2022a, b; Habibie and Flowerdew 2023). Scholars globally are encountering different discursive and non-discursive (Canagarajah 2002) challenges to participate in and contribute to the international knowledge economy. This pivotal role of scholarly publication and the challenges involved have attracted growing research attention over the past two decades, especially in recent years. The gained knowledge and scholarship in this area have accumulated under the newly established and fast-expanding field of English for Research Publication Purposes (ERPP) (see Flowerdew and Habibie 2021).

As an interdisciplinary field within applied linguistics and English for research academic purposes (EAP), ERPP draws on disciplines and domains as diverse as education, sociology of knowledge, politics, economics, colonial studies, and orientalism, to name a few. ERPP also has a multifaceted research approach to the production and dissemination of knowledge and addresses topics and domains including but not limited to (Flowerdew and Habibie 2021; Habibie and Hultgren 2022):

- Analysis of academic discourse
- Social justice in the production and dissemination of knowledge
- Epistemic and linguistic racism in the production and dissemination of knowledge
- Editorial process, its discourses, and the existence of biases in the review process
- Technology-mediated knowledge production and dissemination
- The pedagogy of scholarly publication
- Geopolitics of knowledge production and circulation
- Predatory practices in knowledge construction and communication

A core topic in ERPP that has played a key role in shaping ERPP as a scholarly field is the global challenges that scholars are facing for publishing in English-medium international journals. A review of this scholarship is beyond the patience of this short chapter (see Flowerdew and Habibie 2021 for details), but a couple of issues are noteworthy in this literature. First, this scholarship has focused on more established academics rather than junior and early-career scholars, given higher expectations of those scholars for publication compared to novice scholars. However, we know that in current academia, the publish or perish adage also applies to novice and emerging scholars. Even many graduate students need to publish to

graduate or be visible in the competitive knowledge economy. Second, the bulk of this scholarship has investigated scholarly publication practices of EAL scholars in (semi)peripheral contexts as they are considered to be at a geo-linguistic disadvantage (Flowerdew 2019) compared to their Anglophone peers. The advantaged status of Anglophone scholars, what Habibie calls *lucky Anglophone scholar discourse* (Habibie 2016, 2019), has been the topic of a hot, still open debate in the ERRP discourse community (see Habibie 2016, 2022b; Habibie and Hyland 2019; Hyland 2016 for further details).

The core counter-argument here is that academic literacy is a skill-set that should not be confused with language proficiency and requires explicit and implicit education and training to develop irrespective of one's first language (Habibie 2016, 2019; Hyland 2015, 2016). Therefore, just like EAL scholars, Anglophone scholars, especially junior ones, struggle with academic discourse and scholarly publication and the required literacies for participating in knowledge production and communication cannot be taken-for granted for them. An important implication of this argument is that it draws attention to the fact that the scholarly publication practices of Anglophone scholars are overlooked in ERPP scholarship and deserve further scholarly focus. Consequently, recent years have witnessed a growing interest in the scholarly publication practices of Anglophone academics (e.g., Habibie 2015, 2016; Habibie and Hyland 2019; Habibie and Burgess 2021).

By the same token, in this chapter, we have tried to address the two above-mentioned issues. That is, we have focused on junior and early-career scholars rather than more established scholars, considering the increasing attention to scholarly publication practices of novice and emerging scholars in recent years. Additionally, we have also zoomed in on Anglophone academics as an under-researched and under-represented demographic in ERPP scholarship. We hope that this chapter can provide an overview of the current landscape of ERPP research on this population. The bibliometric data and analysis presented in this chapter can shed light on the dynamics of the existing scholarship in this domain and provide us with a comparative, detailed, and nuanced picture that can complement the knowledge repertoire of EAL scholars. This multifaceted picture can, in turn, highlight further exigencies and avenues of research into scholarly publication practices of both Anglophone and EAL junior scholars.

1.1 Bibliometric Studies in Applied Linguistics

Bibliometric and scientometric reviews are among the recently emerged types of reviews. These more recent types of systematic reviews utilize more systematic and quantitative approaches to research synthesis and are deemed to be more objective in nature than traditional literature reviews, which may lack systematicity and are prone to researcher subjectivity (Chong et al. 2023). By visualizing bibliometric information, we can form a comprehensive overview of the research trends that shape the

landscape of academic literature (Chong et al. 2023; Chong and Plonsky 2023; Gass et al. 2022).

The term "bibliometrics", coined originally by (Pritchard 1969), refers in general to the quantitative analysis of publications in a given research area. Bibliometric research uses mathematical and statistical methods to analyze and measure the quantity of publications (De Bellis 2009). Closely related to bibliometrics is the notion of scientometrics, which is conceptualized as "the quantitative methods of the research on the development of science as an informational process" (Nalimov and Mulchenko 1971, 2). This approach encompasses "ways of measuring research quality and impact, understanding the processes of citations, mapping scientific fields and the use of indicators in research policy and management" (Mingers and Leydesdorff 2015, 1).

Scientometrics uses "relational bibliometrics, a subset of bibliometric methods" (Zakaria and Aryadoust 2023, 2). Bibliometrics is considered to be "a subset of scientometrics, and it is limited to the analysis of publications and their properties" (Gingras 2016, 1). In general, bibliometrics appears to have come to be used as an umbrella term to refer generically to studies utilizing statistical bibliographic data, though some scholars use the two terms (bibliometrics and scientometrics) interchangeably (Mejia et al. 2021). In the field of applied linguistics, both the terms bibliometrics (Lin and Lei 2020; Sun and Lan 2021, 2023) and scientometrics (Aryadoust 2020; Aryadoust and Ang 2021; Liu and Guangwei 2021) have been used in research, notwithstanding their subtle distinctions.

As part of the data analysis in the present review study, we also use VOSviewer software (Van Eck and Waltman 2010), where VOS stands for visualization of similarities. Vosviewer is a Java-based bibliometric visualization software package developed by Leiden University in the Netherlands, designed for constructing and visualizing bibliometric networks, including bibliographic coupling, co-citation and co-occurrence of keywords. Utilizing the affordances of VOSviewer allows us to analyze and visually depict the bibliometric networks and co-occurring keywords in the selected studies (as will be explained in the following section). Methodologically, this study, to our knowledge, is the first study on writing for scholarly publication to use bibliometric analysis and thematic visualization.

1.2 The Present Review

As noted earlier, although recent research has begun to address the writing-for-publication practices of Anglophone doctoral students (e.g., Fazel 2019; Habibie 2015, 2016) and emerging scholars (e.g., Kohls 2021; Van Viegen 2021), this narrow yet growing strand of literature appears to be dispersed and fragmented across different disciplines, geographical regions, and publication venues. Thus, a systematic bibliometric review is needed to bring together these disparate threads of research in this thriving area of investigation, which can bear important implications for policy and practice and shed light on further avenues of research and inquiry.

The overarching goal of this bibliometric review is thus to assess the current and emerging knowledge base about academic publication practices of novice Anglophone (L1) scholars and the implications thereof for interested parties and stakeholders in this fast-growing area of research. More specifically, we aimed to identify what kind of research exists (as well as where it is emerging and emanating from), who it typically involves, and what topics stand out most on the basis of this body of literature.

In accordance with the focus and thrust of this review, we approached the scholarly literature with the following focal areas of inquiry (research questions):

- What are the basic trends with regard to when and where (i.e., publication venue) the relevant research has been published (publication trends)?
- Who are often the participants in this line of research?
- Where and in what disciplines does this research tend to occur and predominate (disciplinary context and geographical setting of the studies)?
- What are the key characteristics of research in this line of investigation with regard to research foci, methodology, and theory (Research foci)?

Following this introduction, the methodological procedures utilized for data collection and analysis in this systematic review will be laid out. Subsequently, the results and findings emerging from the analysis will be presented (in Sect. 3, Results), followed by a concluding section (Conclusions, Sect. 4), where the interpretations made, as well as conclusions and recommendations drawn from the findings of the review, will be provided.

2 Methodology

2.1 Data Sources and Search Strategies

Multiple steps were undertaken in compiling the current corpus. Initially, we conducted searches of the online databases – Web of Science (WoS) Core Collection database, Education Resources Information Center (ERIC), Scopus, Education Database (ProQuest), Education Research Complete (EBSCO), and Academic Search Complete, commonly used databases of research publications and citations (Baa et al. 2020; Birkle et al. 2020; Waltman and Larivière 2020) – to identify the relevant literature published between the years 1980 and 2023 available in English. The search for relevant studies was conducted using the keywords and phrases revolving around publication practices of Anglophone novice scholars (including academic publishing, writing for publication, junior academics, junior scholars, novice scholars, novice academics, native speaker scholars, novice Anglophone scholars) as well as their collocation synonyms and variants in terminology (including research production, research productivity, knowledge dissemination, and research-knowledge sharing).

Keywords were truncated and combined through Boolean operators ("AND", "OR") to conduct search strings in titles, keywords, and abstracts to optimize search results. Another complementary strategy employed was to carefully examine the reference lists of the identified publications for citations of additional relevant studies. Once an item was located via electronic search, the abstract was carefully perused to ensure its relevance, and subsequently, the publication was downloaded from the libraries of universities where we serve (University of British Columbia and Western University). We then scrutinized each identified item to discern whether or not it met the criteria for being included in the corpus.

2.1.1 Inclusion Criteria

The eligibility (inclusion) criteria included peer-reviewed journal articles or book chapters in edited volumes (included in the aforementioned data bases) that were based on empirical research with a clear focus on the academic publishing practices of Anglophone novice scholars (graduate students and early career researchers). The term 'empirical' research in this review refers to studies that have reported findings from an analysis of primary data, following Creswell's (2013) principles of research design as a guiding framework. It is also important to note that the term 'early career researchers' (ECR, as a shorthand) in this review is conceptualized based on Bazeley's (2003, 275) definition of early career researchers as persons engaged in "their first five years of academic or other research-related employment".

It is worth noting that studies with both L1 and EAL (L2) participants (e.g., Shvidko and Atkinson 2018) and those involving both novice and more experienced academics (including, for example, supervisors (as in Dowling et al. 2012) were also considered in the review. Also included in the corpus were studies involving 'Thesis by Publication' (TBP), otherwise known as 'PhD by Publication', which has gained prominence over the past two decades (Chong and Johnson 2022).

2.1.2 Exclusion Criteria

The following publications, which did not meet the above-mentioned inclusion criteria, were excluded from the corpus:

- Publications that were not empirical, including commentaries, editorials, conceptual papers, book reviews and review studies.
- Studies that consisted solely of EAL novice scholar participants
- Studies involving experienced rather than novice Anglophone scholars
- Studies with insufficient data regarding the language background and academic status of their participants.

In cases where the language background was not specified, an attempt was made to infer the linguistic background of the participants, drawing on demographic or other background information such as nationality or ethnic background. For example,

some studies had used words such as "Caucasian" or "domestic" rather than Anglophone or English-speaking to refer to their participants and were determined to have met the inclusion criteria. Where it was not possible to determine or infer the linguistic background of participants, the study was excluded. Also excluded were research publications that only made tangential references to the topic yet did not focus on scholarly publications of Anglophone novice scholars. Studies that did not involve human participants were also excluded from the study. For instance, studies (lacking participants) whose sole focus was statistical analysis of textual or archival data of dissertation formats or policy documents regarding determinants of hiring and promotion were excluded from the corpus.

The initial searches resulted in a total of 194 publications; nonetheless, following the strict application of inclusion and exclusion criteria and removal of duplicates, we were left with 50 records (i.e., empirical publications, including journal articles and book chapters) for use in the review. Subsequently, we conducted a general Google Scholar search and did not discover any additional results. The remaining search results were retrieved and imported into an Excel spreadsheet in preparation for the data analysis, as follows. Though every attempt was made to capture as many relevant records as possible, we cannot claim the attained corpus is by any means comprehensive and exhaustive.

2.2 Data Analysis

To gain a deeper insight into the topic under inquiry, two different yet related layers of data analysis (manual coding followed by a bibliometric analysis of the dataset) were methodically and purposefully performed in this analytic review, which will be explicated in the sections that follow under separate headings.

2.2.1 Manual Coding of the Data

The first layer of data analysis entailed the two authors' manual coding of the data. To that end, we first developed a coding matrix consisting of the following categories (in accordance with the research questions of the study, as specified earlier):

- Full bibliographic data (including authors, year and venue of publication) for each reference
- Participants' demographic data for each study
- Disciplinary context of the study participants in each study
- Geographic context of a study
- Research foci (gleaned from research questions)
- Methods
- Data Sources

Following the recommended data analysis protocols and procedures (Creswell 2013), the studies were first carefully read and individually coded, using the above categories. We subsequently compared our coding, and noted the disagreements. Discrepancies in coding were then resolved through discussion and re-analysis, where necessary, until consensus was reached. The coding scheme was also modified to reflect the latest agreed-upon changes in thematic categories. All the remaining studies were then subject to coding, using the finalized coding scheme, to identify the descriptive attributes and thematic contents in our corpus of studies (See Table S in the Appendix for full bibliographic information for each publication included in the current review.)

2.2.2 Bibliometric Analysis of the Data

In addition to and following the above-mentioned manual coding, a bibliometric data analysis using VOSViewer was performed in order to create a network map of co-occurring keywords sourced from the most impactful publications in the corpus. Researchers employ a number of tools to conduct bibliometric analyses. Chief among such tools are VOSViewer (Waltman et al. 2010), the Bibliometrix package in RStudio, as well as SciMAT (Herrera and Heras-Rosas 2021). These three commonly used bibliometric software packages each have their merits and demerits. The Bibliometrix package, using RStudio, provides SciMAT provides unique modules, which distinctly allow for performing most if not all, types of visual mapping. VOSViewer is often presumed to be comparatively user-friendly and capable of cleaning up raw bibliometric data (Cobo et al. 2012).

Using the bibliographic information from the 50 studies, a bibliometric analysis was conducted using VOSViewer software version 1.6.19, which visually displayed the co-occurrences of keywords and thematic patterns in the gleaned corpus of studies. With the aid of VOSViewer Data Visualization, we were able to visually depict the evolving thematic patterns and trends in the data and discern the evolution of salient topics over time, as will be explicated in the following section (Results).

3 Results and Discussion

Our review primarily sought to identify the key trends in the empirical literature on publication pursuits of L1 novice academics in terms of what (the focus and thrust), when, where (disciplinary and geographical contexts), and on whom (participants), the research was undertaken, and what methodology and theory were employed.

In what follows, we present the results emerging from the data analysis (from both manual coding and limited bibliometric analysis of data) based on the themes and categories corresponding to the Research Questions posited earlier. It is important to note that, given the emergence of the first publication in this vein in 2001 (Dinham and Scott 2001), we present the published empirical studies across two

distinct periods, namely, 2001–2011, and 2012–2023. In presenting the results, percentages have been rounded to the closest whole number for simplicity and clarity of presentation and comparison.

3.1 Analysis of Data Based on Manual Coding

3.1.1 Publication Trends

In the past two decades following the turn of the new millennium, there has been an exponential growth in the number of studies on publication practices of novice Anglophone academics. Statistical analyses of the number of publications that have emerged every year can serve to cast light on the current state of research and future trends in this important area, as summarized in Fig. 1 below.

The trend shown in Fig. 1 demonstrates how research in this vein has attracted increasing scholarly attention. In terms of the sheer number of annual publications, before 2018, there were only 12 publications in this area cumulatively, with only 2 published studies per year in this area. However, this number has more than tripled in the past five years, bringing the total number of publications to 50 on aggregate. The number of annual publications rose to 10 and 13 publications per annum in 2020 and 2021, respectively, before declining again to 5 as of 2022 (likely due to the emergence of the pandemic and the associated logistical difficulties of undertaking empirical research). Quite conceivably, though, the numbers will pick up again with the pandemic era coming to an end.

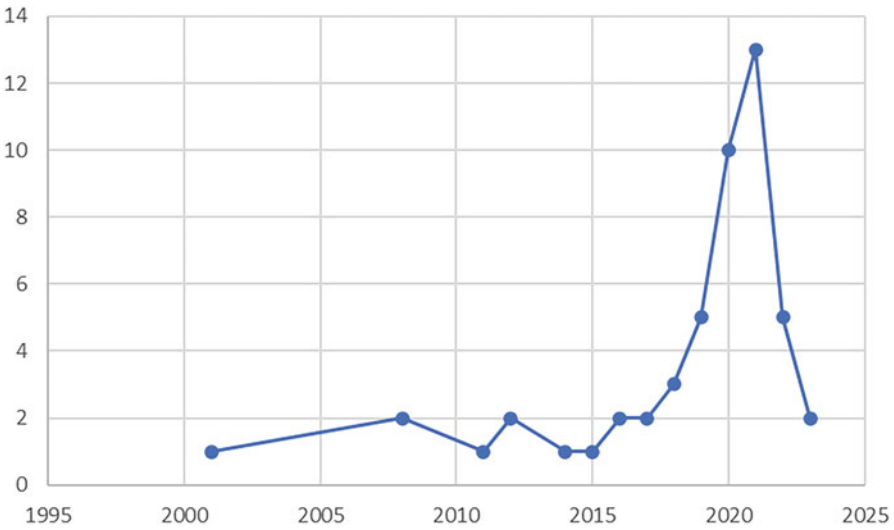


Fig. 1 Quantitative distribution of published studies, 2001–2023

Table 1 Breakdown of publication venues across the two periods and overall

Publication Venue	2001–2011	2012–2023	Total
Book chapter	0 (0%)	11 (24%)	11 (22%)
Journal article	4 (100%)	35 (76%)	39 (78%)
Total	**4 (100%)**	**46 (100%)**	**50 (100%)**

Table 2 Breakdown of book chapters

Edited volume	Year of publication	Discipline	Number of related chapters
Badenhorst & C. Geurin (Eds.)	2016	Applied linguistics	1 (9%)
Habibie and Hyland	2019	ERPP	2 (18%)
Habibie and Burgess	2021	ERPP	6 (55%)
Chong and Johnson	2022	Education	2 (18%)
Total			**11 (100%)**

The overwhelming majority (over three quarters) of empirical studies, as shown in Table 1, were published in peer-reviewed academic journals, which is quite expected given the premium placed by academic stakeholders on journal publications as the main yardstick of scholarly productivity. Book chapters seem to have come to the fore just in the past ten years or so. Interestingly, all of the book chapter contributors, except for one in Social Sciences, were either in Education (n = 2) or in Language Education (Applied Linguistics/TESOL, n = 8), reflecting the differential disciplinary and hierarchical value placed on book chapters.

The 50 records retrieved were published in 26 different publication venues, including 22 different academic journals and 4 edited volumes scattered across various disciplines. We were also interested in exploring the disciplinary focus and nature of the publication venues for this literature. The book chapters were distributed in 4 different edited volumes, with one being in the general field of Education and three in ERPP and more generally in the realm of Applied Linguistics, as summarized in the Table 2 above – with over half (55%) of those published in Habibie and Burgess (2021), followed by 18% appearing in Habibie and Hyland (2019) and Chong and Johnson (2022).

We were also interested in exploring the disciplinary foci of the journals where the relevant literature was published. As revealed by Fig. 2 (below), Higher Education journals appeared to have the lion's share in terms of publications in this area (i.e., publication activities and practices of Anglophone novice scholars), followed by Communication and Education journals. It is also worth noting that the journals tagged as being in the Higher Education realm have the key phrase "Higher Education" as part of their title, including, for example, "The Higher Education Journal" (n = 7 of 14 studies), or Journal of Further and Higher Education (n = 2).

It is worth pointing out that TESOL/Applied Linguistics journals have only attracted minimal scholarly attention in this regard thus far, conceivably due to the traditional focus of the field on discursive challenges facing EAL writers, which also points to the need for a more proactive role to be played by Applied Linguistics in

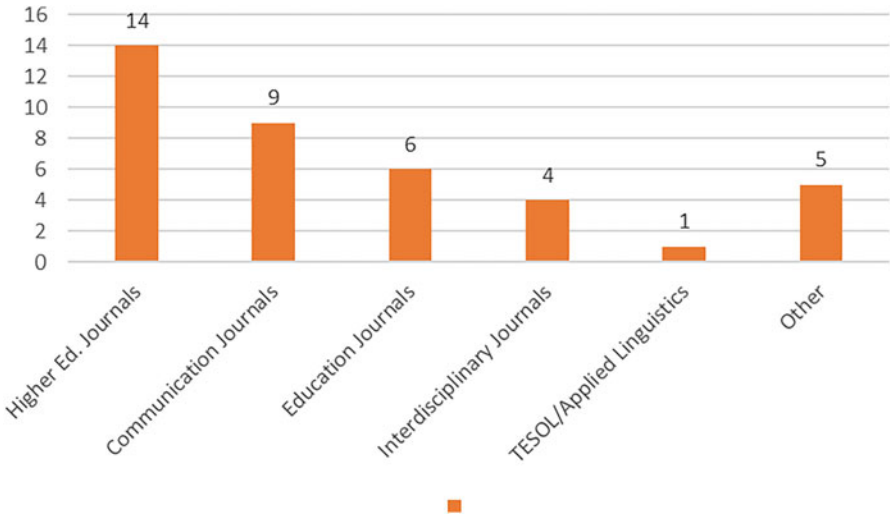


Fig. 2 Breakdown of Journals

general and in particular by the newly emerged sub-field of ERPP, which is the area of expertise dedicated particularly to assessing and addressing the publication-related challenges (discursive or otherwise) facing novice academics, as noted by Flowerdew and Habibie (2021).

3.1.2 Participants and Contexts/Settings

Turning now to the participants and their attributional and contextual variables, a glance at Fig. 3 (below) reveals the tendency of the extant literature to lean more towards the publication practices of early-career researchers., which is understandable given the high-stakes and consequential nature of research and publication output for this group of participants. It is worth noting that recent PhD graduates are often on the verge of embarking upon their academic careers, which further tips the scale toward early career academics. A comparatively smaller group of studies seems to be focally attending graduate students' publication practices. A closer inspection of the data suggests that this strand of research has emerged and grown mainly in the past ten years, in tandem with the intensifying pressure on graduate, especially doctoral-level, students to publish as a means of enhancing their employability prospects, given the burgeoning competitiveness of the academic job market, as highlighted in studies in this vein (e.g., Cuthbert and Spark 2008).

Another factor contributing to the growth of this latter line of research (on graduate students) is the emergence and increasing popularity of Thesis by Publication (TBP, as a shorthand), particularly in Australia, New Zealand, and many European countries, which has intensified the demand on the part of doctoral

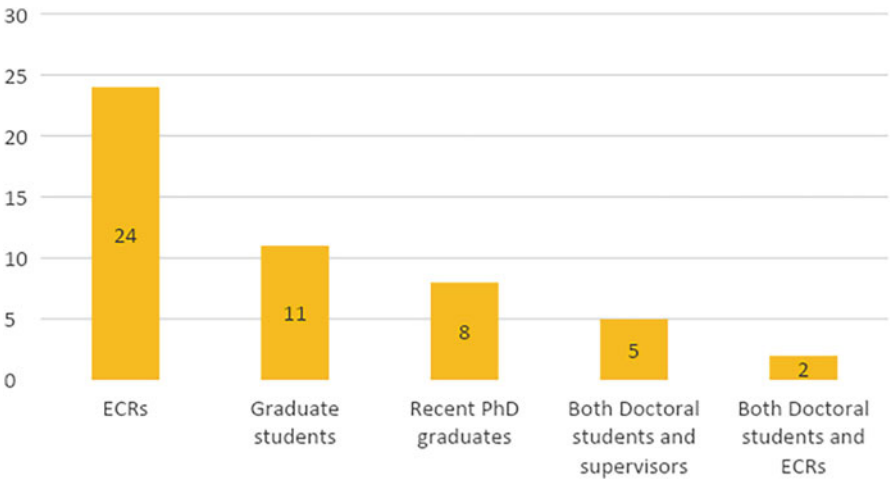
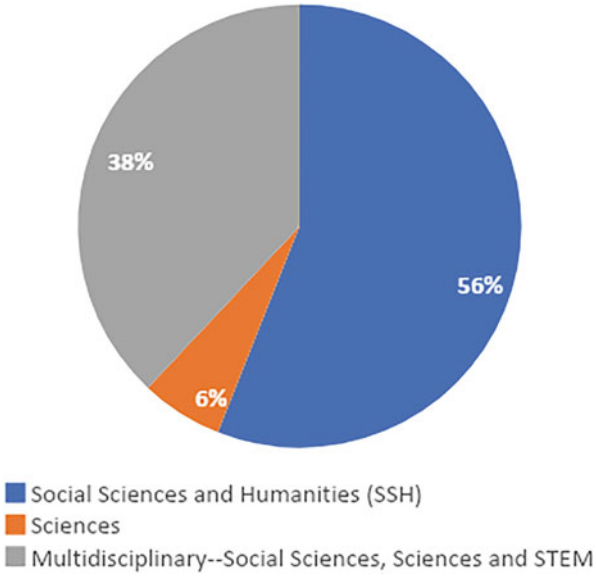


Fig. 3 Participants' academic rank

Fig. 4 Disciplinary backgrounds of the participants



students to learn the ropes of academic publishing as a requirement for graduation and degree conferral.

In terms of disciplinary contexts, overall (as displayed in Fig. 4 above), a considerable number of studies involved participants in Social Sciences and Humanities, with only a modest number of studies attending to those in Sciences.

Upon closer scrutiny of the relevant data, it transpired that the past decade has witnessed an unprecedented surge in the number of publication-related studies

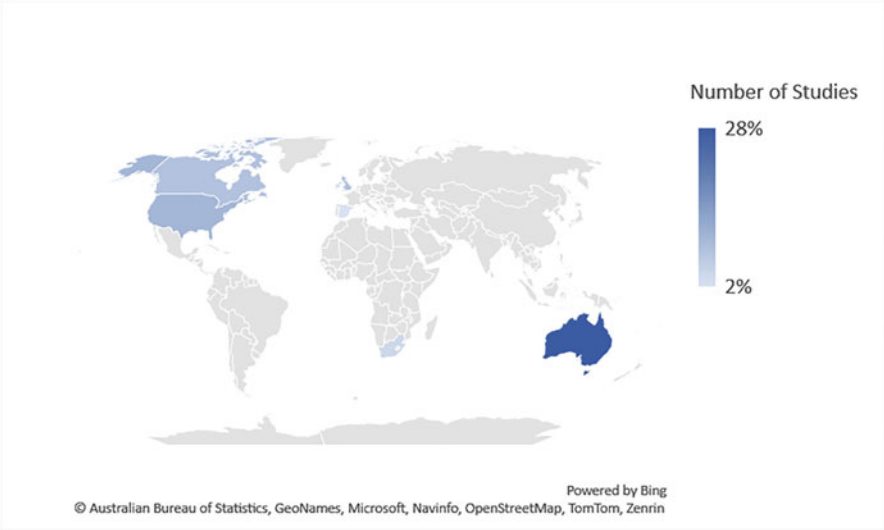


Fig. 5 Geographical contexts of the studies

focusing on Social Sciences and Humanities, which likely reflects the emerging needs, exigencies, and burgeoning institutional demands in these disciplines to produce publications as a measure of academic productivity and accountability, consistent with today's zeitgeist of knowledge economy, where knowledge workers are bound to showcase and maximize their production to stay competitive enough on the job market. In fact, the number of such studies has tripled only in the past five years – increasing from just 8 to 24 studies, which likely reflects the growing demand to publish in these disciplines over time.

On a more granular, field-specific level, studies in Education contributed the largest share of studies, with under one-third (28%) of the studies, followed by studies in TESOL/Applied Linguistics, which comprised almost one-fifth (9 of the 50). Education and Language Education (Applied Linguistics/TESOL) combined account for almost half of the corpus (23 out of 50). Notwithstanding the substantial contribution of the field to the literature in this area, somewhat surprisingly, however, the results of such research tended not to be published in discipline-specific (Applied Linguistics/TESOL) journals but rather in Education or Higher Education journals, possibly on account of higher impact factors associated with those journals, which highlights the unfortunate dominance of a metric-based performativity system in the world of academic publishing.

Regarding the geographical distribution of studies, as displayed in Fig. 5, the contexts of the reviewed studies were heavily skewed towards geographical regions where English is the main or official language, that is, North America, Australia, New Zealand and English-speaking countries in Europe including Ireland and the UK, which is expected given the thrust of research in this area.

In terms of the breakdown of the literature across different countries, Australia was the most remarkable contributor (40% of the literature) to the relevant literature – with 28% of studies occurring just in Australia and 12% involving Australia and another country (cross-contextual studies). It's worth noting that studies emanating from Australia predominantly focused on TBP. North American countries were the next substantial contributors to the literature – USA (10%) and Canada (8%). Also noteworthy is the growth of multi-site, cross-contextual research involving more than two countries, which comprised 26% of the literature in this area.

3.1.3 Research Foci

Data analysis indicated that the literature has predominantly examined the experiences with writing for publication (76% of studies), including experiences with writing a TBP, which comprises 47% of these studies. TBD-related research has shown a 72-percent increase just over the last five years and can be safely anticipated to maintain its expedited growth and uptake, as it is potentially conducive to more publication productivity, a much-valued merit in today's academia.

Figure 6 also indicates a rather recent salient focus in the literature on the analysis of experiences of participants' engagement in scholarly publication endeavors. Such experiences may be subject to analysis by external researchers (etic analysis) or analyzed reflexively by the participants themselves. The latter constitutes a growing trend towards using introspective and self-reflective narrative inquiries, whereby one's own experiences are subject to emic analysis, often through autoethnography

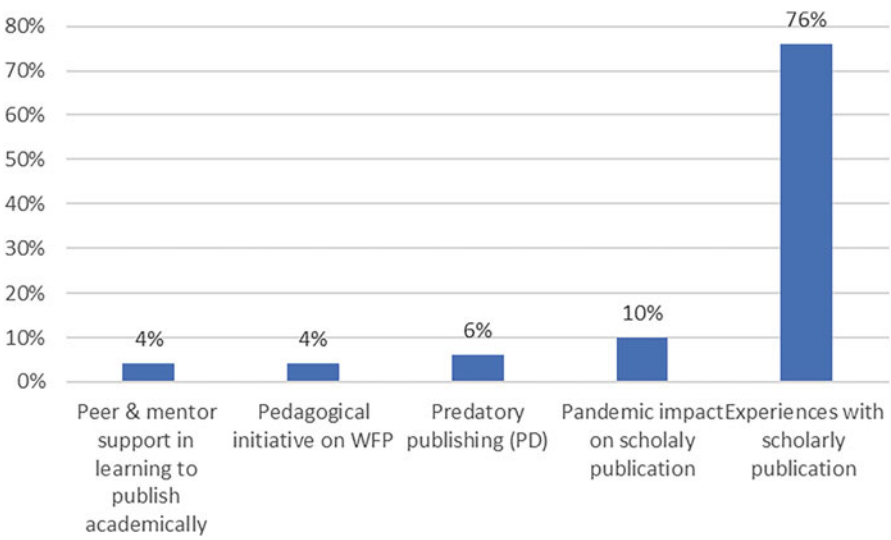


Fig. 6 Research foci of the studies

or self-reflection, a qualitative method inquiry which we will pick up again in the next section (Sect. 3.1.4).

The studies focusing on experiences of writing for publication often employ an analysis of the relevant data from a student perspective or joint experiential explorations and exchanges between students and supervisors (e.g., Baverstock and Wenger 2018). Such studies may involve more than two participants as well. For instance, Dowling et al. (2012), where a PhD supervisor and three doctoral students co-author a reflective account of their experience in navigating the trajectory of TBD and the issues, challenges and implications thereof.

Ferrell et al. (2019), in a different study, involved the participation of two PhD students and a Dissertation Chair. Another recent area of focus identified in the literature is the analytic assessment of the impacts and implications of the pandemic on the scholarly publication and productivity of novice scholars, especially early-career scholars (e.g., Beverstock and Pickersgill 2022; Nicholas et al. 2022a, b, c), with researchers voicing concerns, quite legitimately, about the potential long-term ramifications of the pandemic for early-career researchers, and calls for measures to mitigate the potential adverse corollaries emanating from the pandemic (e.g., Jamali et al. 2023).

The emergence and proliferation of the phenomenon of predatory publishing is yet another noteworthy perplexing issue that has attracted an enormous and increasing amount of angst and attention in the scholarly communities, cutting across disciplinary and geographical boundaries (Habibie and Fazel 2023). Needless to say, inexperienced scholars (irrespective of their linguistic background) who conceivably lack the requisite skills and sensibilities to detect suspicious journals and publishers (and even sham and fraudulent conferences) are often the prime targets of such predatory practices, as reported in the recent relevant literature (e.g., Fazel and Hartse 2017; Fazel and Hartse 2020). A particularly revelatory and relevant study in the corpus is Taylor (2019), who critically and reflectively reports on his first-hand experiences of engagement with suspicious, at best, presumptively predatory journals. Pursuing the same area of concern, Nicholas et al. (2021, 2023) have also conducted research to seek out the early career researchers' perceptions and understandings of predatory publishing in an attempt to help raise the critical cognizance of novice scholars in this regard. Whether or not an in-experienced academic falls prey to a predatory publisher or journal is largely affected by one's novice, rather than native or non-native, status, which calls for preventive and preemptive measures to raise critical awareness in this critical matter.

3.1.4 Research Design and Data Sources

Examination of the research methods utilized by the studies in the corpus revealed a disproportionate emphasis on qualitative (n = 41, 80%) inquiry. The predominance of qualitative methods is not surprising, given that many studies in the corpus tended to focus on investigating experiences often explored through qualitative inquiries (Creswell 2013).

Mixed method and quantitative methodology respectively contributed (n = 6, 12%) and (n = 4, 8%) studies. Scrutinizing the data sources associated with each of the three aforementioned research methods also indicated noteworthy patterns. Among the 40 qualitative studies, 23 were based on self-reflection of the experiences of the authors. That said, only 15 of those 23 studies were explicit in calling their method "autoethnography". These studies were all in Social sciences and Humanities (TESOL =6, Education =12, SSH = 3), which is expected given the predominance of ethnographical research emanating from Anthropology, which has had bearings on Social Sciences and Humanities. Among qualitative studies, interviews served as the next commonly used data source, with 15 studies deploying individual or focus group interviews either alone or in combination with other methods of data collection. As for quantitative studies, the only means of data collection used was closed-ended questionnaire surveys (e.g., Jamali et al. 2023; Nicholas et al. 2020). Interestingly, all those who undertook mixed methods and quantitative investigations were in multi-disciplinary contexts, though these contexts were mainly populated by those with a science background (e.g., Mason et al. 2020a, b, 2021). This observation might indicate the presumed clout and power of hard sciences over soft sciences, which widens the epistemological, ontological, and methodological chasms dividing different polar disciplines.

3.2 Visual Analysis of Data Based on Bibliometric Analysis

As noted earlier in the chapter, we proceeded to run a bibliometric analysis on the available dataset comprising a total of 50 studies. A co-occurrence visual analysis of common terms and keywords gleaned from the available data (50 items) can serve to reveal the prevailing and emerging themes and the evolution of research topics and trends over time. In what follows, we present a bibliometric keywords co-occurrence analysis to depict the main topic distribution and research frontiers in the literature. Keywords arguably constitute an important part of empirical publications, as they carry essential information about the nature and foci of studies. Systematic analyses of keywords in research fields can serve to illuminate the developmental trends and trajectories of research in the field. In bibliometrics, keyword co-occurrence analysis is often used to analyze the strength of links between different keywords in a large number of documents. By analyzing the co-occurrence relationships of the keywords, we can develop a big-picture view of the discipline's existing and evolving research frontiers (Bales et al. 2020).

In order to better understand the relationship among the key terms in the studied literature, given the small-scale of the available corpus with bibliographic information, recurring keywords with a minimum frequency of at least two appearances were set in VOSviewer. A total of 139 keywords appeared in the available collected literature on scholarly publications of novice Anglophone scholars, which was then fed into and analyzed by the VOSviewer and displayed in the following co-occurrence network analyses that follow. Out of 139 total keywords identified,

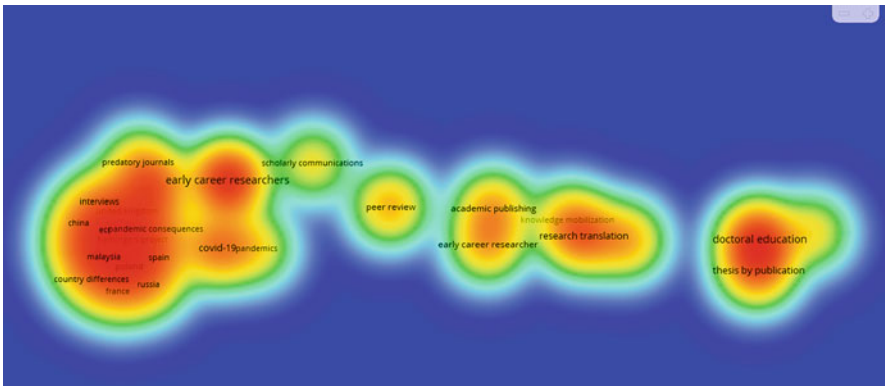


Fig. 7 The density analysis of hot topics in the studies

Fig. 8 Keywords co-occurrence network analysis of studies

29 key terms meeting the aforementioned threshold of having co-occurred at least two times in the screened corpus were identified by the software, and subsequently utilized to generate relevant visualized maps, which will be explicated below. In order to attain a holistic overview of the evolving and emerging trends in the field, first a visualized density analysis is presented in Fig. 7 above.

In Fig. 7, the relevant data are shown as labels and thermographic patches, which portray a visual density analysis of the main research topics in the studies. The color of the thermographic patches reflects the number of papers published pertaining to a given research topic. The larger the number, the warmer (and more glowing) the color of the patches; conversely, the smaller the number, the colder (less glowing) the color of the pertinent patches. As shown in Fig. 7, research topics that have been receiving considerable scholarly attention in the literature include "doctoral education", "thesis by publication", "early career researchers," "research translation", "scholarly communication", as well as "Covid-19", as well as "predatory journals".

As mentioned earlier, VOSviewer was also used to conduct a term co-occurrence analysis, which yielded four clusters with 195 links with a total link strength of 136, as presented in Fig. 8 above. It is important to note that visualization of bibliometric networks typically comprises two elements: nodes (i.e., circle-looking shapes that indicate units being measured or quantified; in this case, each node represents a publication as a unit of analysis) and links (or lines that serve to connect the individual nodes). The node size represents the relative weight associated with

Table 3 Salient keywords as well as their respective occurrences and total link strengths

Cluster	Keyword	Occurrences	Total link strength
Cluster 1 (red)	Covid-19	4	3
	China	2	2
	Country differences	2	2
	ecr[a]	2	2
	France	2	2
	Harbingers project	2	2
	Interviews	2	2
	Malaysia	2	2
	Pandemic consequences	2	2
	Pandemics	2	2
	Poland	2	2
	Predatory journals	2	2
	Russia	2	2
	Scholarly communications	2	2
	Spain	2	2
	UK	2	2
	United Kingdom	2	2
	United States	2	2
Cluster 2 (green)	Research translation	4	3
	Academic publishing	3	2
	Early career researcher	3	3
	Peer review	3	3
	Scholarly publishing	3	3
	Knowledge mobilization	2	2
Cluster 3 (blue)	Doctoral education	6	6
	Thesis by publication	4	4
	PhD by publication	2	1
Cluster 4 (yellow)	Early career researchers	7	5
	Scholarly communication	4	3

Note: [a]"ecr" stands for early career researcher

each unit; thus, a larger circle indicates a larger number of citations or occurrences for that particular publication in the figures displayed below.

As displayed in Fig. 8, it can be clearly seen that the literature under study has formed four distinctly discernible clusters, with significant correlations between the keywords in each cluster. Table 3 displays the salient keywords, their respective occurrences, and total link strengths, which can complement the insight Fig. 8 provides.

To enhance visibility and facilitate analysis, we have enlarged and separated the clusters, which will be analyzed separately and sequentially in what follows.

As shown in Fig. 9, Cluster 1 (Red) represents three prominent and inter-related themes revolving around scholarly publication practices of early career researchers

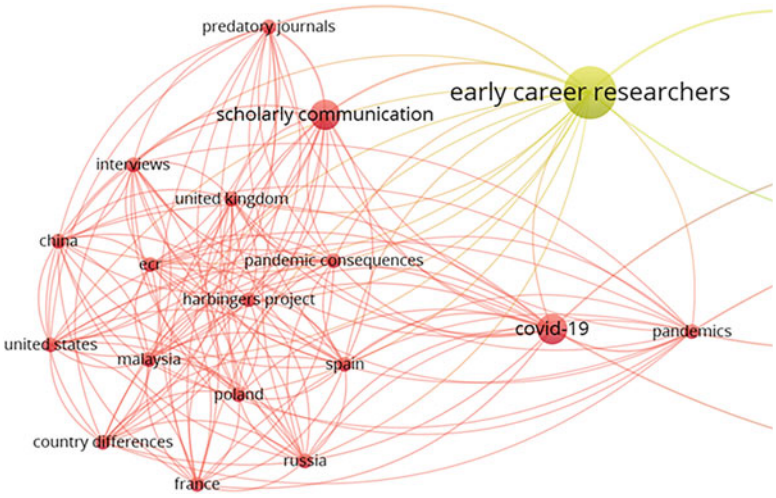


Fig. 9 Cluster Red

(ECRs): (a) Covid-19 pandemic and its consequences for and implications on publishing practices of novice scholars (i.e., ECRs), (b) Predatory practices, which have proliferated in scholarly publication in recent years, a critical issue which has given rise to growing concerns across disciplines, and (c) Harbingers Project, which refers to a cross-contextual longitudinal project (2015–2019) focused on scholarly publication practices of early career researchers (ECRs) from seven countries (China, France, Malaysia, Poland, Spain, UK, and USA), with Russia being added in 2019.

Somewhat similar to the Red Cluster, though with different thematic foci, Cluster 2 (Green) highlights the burgeoning attention to the importance of research translation and knowledge mobilization in ECRs' academic publishing practices. It is worth noting that 'knowledge mobilisation' refers to "the multiple ways in which stronger connections can be made between research, policy and practice' (Levin 2011, 15). A similar notion of 'research translation' is conceived of as disseminating and implementing research findings into practice (MacMahon et al. 2022). In the past decade or so, there have been increasing calls for moving beyond the traditional focus on the mere publication of research and to render research more broadly accessible and usable for wider audiences and users both within and beyond the academic community (Levin 2013; Malin and Brown 2020) (Fig. 10).

Cluster 3 (Blue) manifests the focus on the importance of publishing during the doctorate and the emergence of Thesis by Publication (TBP) and PhD by Publication, which is a growing trend in doctoral education in many universities, particularly in Australia and New Zealand (Mason et al. 2020a, b). It is often argued that PBD can facilitate and catalyze the dissemination of research findings and scholarship, potentially paving the way for the augmentation of knowledge mobilization and translation, highlighted in the Green Cluster (Fig. 11).

Fig. 10 Cluster Green

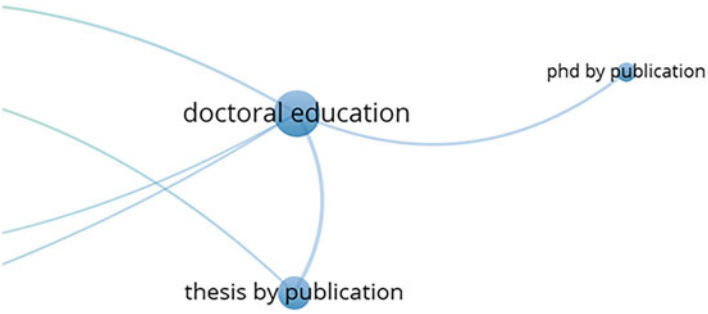


Fig. 11 Cluster Blue

Fig. 12 Cluster Yellow

Finally, the fairly small Yellow cluster comprises the keywords "early career researchers" and "scholarly communications", which again highlights the importance of scholarly communication practices of ECRs, in conjunction with the preceding inter-related clusters depicted above. Importantly, the observation that the key term "ECRs" appears across three clusters (Red, Green, and Yellow) indicates its particular prominence in the relevant scholarly literature (Fig. 12).

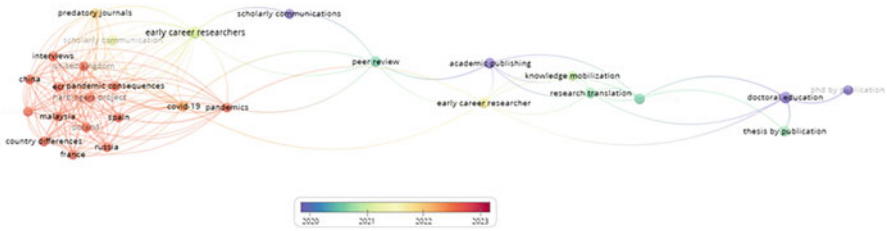


Fig. 13 Visualized overlay (temporal) analysis

In addition to the keyword co-occurrence analysis, VOSViwer also yielded an overlay (temporal) analysis based on keyword co-occurrence patterns, demonstrating the thematic evolution of trends and topics in the analyzed corpus of studies. The overlay visualization is essentially identical to the co-occurrence network visualization, except that the items are colored differently to show the temporal evolution of themes. The color bar in the bottom right corner of the visualization indicates how items (topics) are mapped to colors, with each color representing a particular year–blue (2020), green (2021), orange (2022), and red (2023).

As shown in Fig. 13, the bulk of the literature in this area appears to have amassed between 2020 and 2023, suggesting the recency of the topic. Around the year 2020, the topic of academic publishing in doctoral education and PhD by Publication rose to prominence. Interestingly, the topic of the thesis by publication (TBP), a variant of PhD by Publication, continued to occupy the scholarly spotlight even further toward 2021, highlighting its particular salience in the recent literature. Moving toward 2021, one can see the emergence of other remarkable themes, such as research translation and knowledge mobilization, which seem to be gaining increasing currency in the realm of scholarly publication. Afterward, moving toward 2022, the new topic of 'predatory journals' came to the fore, followed by a subsequent focus on pandemic-related research, given the far-reaching impact of 'COVID-19 on all academic domains, including scholarly publication. More recently, there seems to be a rising trend toward cross-contextual and comparative studies involving early career researchers and their related knowledge mobilization and publication practices.

As shown in Fig. 13, there seems to be a rising trend toward research involving predatory entities, early career researchers, and more cross-contextual and comparative studies. There also appears to be a growing tendency in the related scholarship to expand its scope to adopt more postmodern terms, such as "research translation" and "scholarly communication", beyond somewhat older terms, such as "writing for academic publishing", which emanated from a linguistic/discursive view of scholarly publication, which can be taken to suggest the evolution and expansion in the related scholarly literature, as heralded by the genesis and the burgeoning growth of ERPP (Flowerdew and Habibie 2021). Overall, the bibliometric analyses complemented and corroborated much of the findings gleaned from the manual

coding of the data, with the caveat that the bibliometric analysis merely entailed an analysis of 36 studies.

4 Conclusion

Drawing on the descriptive data analysis (manual coding) as well as the (digital) VOSviewer visualized portrayal of the co-occurring keywords and thematic mapping, in this concluding section, we bring together all the disparate threads of analysis and end with a conclusion and call for further future action and inquiry.

The thrust and focus of this bibliometric review were to offer a distilled overview of the extant published empirical literature on the academic publishing practices, experiences, and perspectives of Anglophone (L1) novice scholars (including doctoral students and early career academics), which constitutes a void in the scholarly literature on writing for academic publication. Consequently, a systematic approach was utilized to obtain the data for this literature review, which was subsequently subjected to both manual coding and bibliometric analysis.

Taken together, the findings reported here overall indicate that the scholarly literature in this area has witnessed a marked uptick in the number of published empirical studies in the past decade or so (especially after 2012), which can be at least in part due to the growing attention paid to the research output and productivity of novice scholars (including both graduate students and ECRs) irrespective of their first language status. This observation is also conceivably indicative of the mounting pressure on academics to publish across disciplinary and geographical borders, a corollary of the burgeoning neo-liberalization of universities (Habibie 2022b; Slaughter and Rhoades 2004). In this context, higher education institutions are increasingly vying for rankings in both domestic and global hierarchies, often based on research and publication output, which exacerbates the pressure on academics for more research publications (Englund and Gerdin 2023; Morrissey 2015; Olssen 2016).

As with many others, the scholarly landscape in this area is fast shifting and evolving to cater to the emerging exigencies and demands in today's globalized knowledge economy. There has been a surge in the studies in this line of research, particularly in the past 5 years, which indexes a burgeoning scholarly interest in this area, at least in part prompted by the genesis and increasing popularity of PhD by Publication, otherwise known as Thesis by Publication, especially in Social Sciences and Humanities (See Paltridge and Starfield 2023, for a full overview).

The analysis also suggests an increasing trend in most studies to involve early career researchers (ECRs), with comparatively less research involving doctoral students. Furthermore, thus far, studies have tended to recruit participants in the local contexts of English-speaking countries, though there is a discernible more recent tendency toward undertaking cross-contextual research in this area, as evidenced by both the bibliometric analysis and manual coding. Regarding disciplinary contexts, participants were mainly from Social Sciences and Humanities or

multi-disciplinary groups, with only a minority of studies involving Sciences. Another interesting finding was the mismatch between disciplinary contexts and discipline-specific journals. In other words, while the general expectation and premise is that scholars would publish within the journals in their disciplinary realms, it has emerged that it is not always or often the case. This imbalance might be accounted for by the fact that journals vary considerably in terms of their impact factor and prestige markers they are indexical of. Future research can shed more light on the underlying motivations behind selecting venues of publication in other disciplines rather than in one's discipline-specific journals.

In terms of research foci, a distinct focus standing out among the studies in the corpus was analysis of experiences with scholarly publication, both with TBP and overall, which constituted over three fourth of the studies. The findings also demonstrate a notable and increasing tendency toward TBP as a more viable alternative to the traditional PhD route for doctoral education. The literature in this area has attracted considerable attention in the recent decade, with 47% percent of the total literature dedicated to inquiries focusing on TBP.

Other recurring themes gleaned from both the manual and bibliometric analysis of data include research exploring the pandemic repercussions on research output and publication productivity of early career researchers, as well as the academy-wide issue of predatory practices, an ostensibly proliferating phenomenon that has insidiously invaded all academic disciplines across the geographical spectrum (Habibie and Fazel 2023).

With regard to research paradigms, qualitatively-designed studies appear to predominate in the bulk of the empirical literature in this area of research. Qualitative inquiries can be potentially conducive to an in-depth and contextualized understanding of the phenomenon under study. Also of note is the burgeoning uptake of autoethnographic inquiries in this line of investigation, particularly by Social Sciences and Humanities scholars. Quantitative and mixed-methods research designs appear to be thus far rather marginalized in this body of scholarship, which suggests an area where further hands-on training and apprenticeship are geared toward affording familiarity with various powerful research techniques to researchers in this area and beyond. Future studies in this area can employ mixed methods research design, which allows researchers to capitalize on the strengths of both qualitative and quantitative research designs (Riazi and Candlin 2014) to capture the breadth and depth and explain the complexity of scholarly publication as a multifaceted phenomenon.

Appendix (Table S)

Table S Review matrix

	Reference	Year	Publication venue①	Participants②	Disciplinary context of study③	Geographical context of study	Research foci④	Methods⑤	Data sources
1.	Anderson and Okuda	2019	J	DS	SSH	Canada	TBP/Ex	QL	Autoethnography
2.	Baverstock and Wenger	2018	J	DS + SR	SSH	UK	TBP/Ex	QL	Reflections on personal experiences
3.	Beverstock and Pickersgill	2022	J	ECR	S	UK	PAN	QL	Interview
4.	Cahusac de Caux	2021	J	DS	Multi	Multiple countries	PAN	MM	Survey + (follow-up) interview
5.	Cargill and Smernik	2016	J	GS	S	Australia	PG	QL	Survey
6.	Cuthbert and Spark	2008	J	GS	SSH	Australia	PG	QL	Interview
7.	Deroo	2021	B	ECR	SSH	US	SUP	QL	Autoethnography
8.	Dinham and Scott	2001	J	RPG	SSH	Multiple countries	EX	QL	Qualitative survey
9.	Dowling et al.	2012	J	DS + SR	SSH	Australia	TBP/Ex	QL	Autoethnography
10.	Fazel	2019	B	DS	SSH	Canada	EX	QL	Case study-semi-structured interviews

11.	Ferrell et al.	2019	J	DS + Diss./CH	SSH	USA	TBP/Ex	QL	Autoethnography
12.	Gormley	2021	B	ECR	SSH	Ireland	EX	QL	Autoethnography
13.	Grant	2011	J	DS	SSH	South Africa	TBP/Ex	QL	Reflections on personal experiences
14.	Habibie	2016	B	DS	SSH	Canada	EX	QL	Case study-interview
15.	Jalongo et al.	2014	J	DS	SSH	Multiple countries	EX	QL	Interview
16.	Jamali et al.	2020a	J	ECR	Multi	Multiple countries	EX	QN	Questionnaire survey
17.	Jamali et al.	2020b	J	ECR	Multi	Multiple countries	EX	QN	Questionnaire survey
18.	Jamali et al.	2023	J	ECR	Multi	Multiple countries	PAN	QN	Questionnaire survey
19.	Jowsey et al.	2020	J	DS + SR	S	Australia and New Zealand	TBP/Ex	QL	Open-ended survey
20.	Kohls	2021	B	ECR	SSH	US	EX	QL	Autoethnography
21.	Liardét and Thompson	2022	J	DS + SR	Multi	Australia	TBP/Ex	MM	Questionnaire + qualitative interviews
22.	Mason	2018	J	RPG	SSH	Australia	TBP/Ex	QL	Reflections on personal experiences
23.	Mason et al.	2022	B	ECR	SSH	Australia	TBP/Ex	QL	Autoethnography
24.	Mason et al.	2020a	J	RPG	Multi	Australia	TBP/Ex	MM	Survey with QN and QL data
25.	Mason et al.	2020b	J	RPG	Multi	Australia	TBP/Ex	MM	Survey with QN and QL data

(continued)

Table S (continued)

	Reference	Year	Publication venue①	Participants②	Disciplinary context of study③	Geographical context of study	Research foci④	Methods⑤	Data sources
26.	Mason et al.	2021	J	RPG	Multi	Australia	TBP/Ex	MM	Survey with QN and QL data
27.	McCulloch	2021	J	ECR	SSH	England	EX	QL	Autoethnography
28.	Merga	2015	J	DS	SSH	Australia	TBP/Ex	QL	Autoethnography
29.	Merga	2021	J	ECR	SSH	Australia	EX	QL	Autoethnography
30.	Merga and Mason	2021a	J	ECR	Multi	Australia	EX	QL	Interview
31.	Merga and Mason	2021b	J	ECR	Multi	Australia and Japan	SUP	QL	Interview
32.	Merga and Mason	2020	J	ECR	Multi	Australia and Japan	EX	QL	Interview
33.	Merga and Mason	2021c	J	ECR	Multi	Australia and Japan	EX	QL	Interview
34.	Merga et al.	2018	J	ECR	SSH	Australia and Japan	EX	QL	Autoethnography
35.	Nicholas et al.	2017	J	ECR	Multi	Multiple countries	EX	QL	Interview
36.	Nicholas et al.	2021	J	ECR	Multi	Multiple countries	PD	MM	Interview + questionnaire
37.	Nicholas et al.	2020	J	ECR	Multi	Multiple countries	EX	QN	Questionnaire
38.	Nicholas et al.	2020	J	ECR	Multi	Multiple countries	EX	QL	Interview
39.	Nicholas et al.	2022a	J	ECR	Multi	Multiple countries	PAN	QL	Interview
40.	Nicholas et al.	2022b	J	ECR	Multi		PAN	QL	Interview

						Multiple countries			
41.	Nicholas et al.	2023	J	ECR	Multi	Multiple countries	PD	QL	Interview
42.	Niven and Grant	Niven and Grant 2012	J	RPG	SSH	South Africa	TBP/Ex	QL	Reflections on personal experiences
43.	O'Keeffe	2020	J	RPG	SSH	Australia	TBP/Ex	QL	Autoethnography
44.	O'Keefe	2022	B	ECR	SSH	Australia	TBP/Ex	QL	Autoethnography
45.	Peacock	2017	J	RPG	SSH	Scotland (UK)	TBP/Ex	QL	Reflections on personal experiences
46.	Robins and Kanowski	2008	J	DS	SSH	Australia	TBP/Ex	QL	Reflections on personal experiences
47.	Shaw	2021	B	ECR	SSH	Spain	EX	QL	Autoethnography
48.	Shvidko and Atkinson	2018	B	ECR	SSH		EX	QL	Interview
49.	Taylor	2019	J	GS	SSH	US	PD	QL	Reflections on personal experiences
50.	Van Viegen	2021	B	ECR	SSH	US	EX	QL	Autoethnography

Legend:
1. *J* Journal, *B* book chapter
2. *DS* doctoral student, *GS* graduate student, *RPG* recent PhD graduate, *ECR* early career researcher, *SR* supervisor, *Diss/CH* Diss. Chair
3. *SSH* Social sciences and humanities, *S* sciences, *Muli* multi-disciplinary
4. *EX* experiences with scholarly publication, *TBP/Ex* experiences with thesis by publication (TBP), *SUP* support (by mentors/supervisors or peers) in learning to publish academically, *PG* pedagogical initiative on WFP, *PAN* pandemic impact on scholarly publication, *PD* predatory publishing (PD)
5. *QL* qualitative, *QN* quantitative, *MM* mixed-method

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Bibliometrix: Science Mapping Analysis with R Biblioshiny Based on Web of Science in Applied Linguistics

Babak Daneshvar Ghorbani

1 Introduction

Today, more scientific information is being made than in the past, and keeping up with everything published is getting more complicated. Furthermore, it is increasingly referred to as multidisciplinary science (Linnenluecke et al. 2020; Ware and Mabe 2015; Briner and Denyer 2012). Henceforth, a significant step toward cumulative scientific knowledge advancement is the synthesis of past research findings and bibliometric data (Aria and Cuccurullo 2017). Globalization has led to the disappearance of borders, information spread, and scientific knowledge advancement. Furthermore, bibliometric studies shed light on assessing the scientific literature by quantitative attitude. These investigations offer a readable, organized, and repeatable literature review.

For a decade, bibliometric analysis has been extended to all disciplines. However, the field of Applied Linguistics, which is relatively new, has witnessed a great deal of data, multiple studies, and many scientific publications. It is getting harder and more challenging for applied linguists to deal with large and fragmented volumes of data, and in light of the rapid increase in resources in the field of applied linguistics and its various strands, the concept of science mapping has become increasingly important in order to understand the current state of the art, connections, opportunities, and main players within an established community of practitioners, themes, as well as relationships between authors and institutions. (Guler et al. 2016). It is important to draw a diagram showing the interconnectedness of items like research data, locations, themes, and author-to-author and author-to-institutional ties (Şenel and Demir 2018).

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According to Shi et al. (2020), bibliometric analysis is a computer program that analyzes data to determine its metrological and content characteristics. Hence, it is an objective and reliable method based on statistical techniques for analyzing information (Broadus 1987; Diodato and Gellatly 2013). Bibliometric analysis is complex due to the fact that it involves several steps. For this purpose, it is necessary to use a variety of complex and varied analysis and mapping tools, some of which may only be made available under a commercial license.

Bibliometric analysis can be done with numerous software or package programs such as VOSviewer (Eck et al. 2010), CiteSpace (Chen 2006), SciMAT (Cobo et al. 2012), Bibexcel, Biblioshiny (Aria and Cuccurullo 2017). This chapter aims to provide a thorough introduction to a free, open-source R package for conducting a systematic study of scientific literature. Moreover, The Bibliometrix package offers a collection of quantitative research instruments for bibliometrics and scientometrics. To do so, Biblioshiny integrates the features of the bibliometrix package with the simplicity of the Shiny package environment for web applications. Besides, the attributes of the bibliometrix package and the convenience of the Shiny-based web application for users led to Biblioshiny's popularity (Aria and Cuccurullo 2017).

This chapter aims to provide a general and systematic overview of scientometric studies. To do this, I developed a project to map out the status of two topics published in Language and Linguistics and Education and Educational Research. In addition, comprehensive information about the English language and technology-related publications is described in detail, and PRISMA guidelines have been followed in extracting and filtering data from WoS.

Three sections have been created to carry out bibliometric research using Biblioshiny: (1) data collection, (2) data entering and (3) data visualization (Fig. 1).

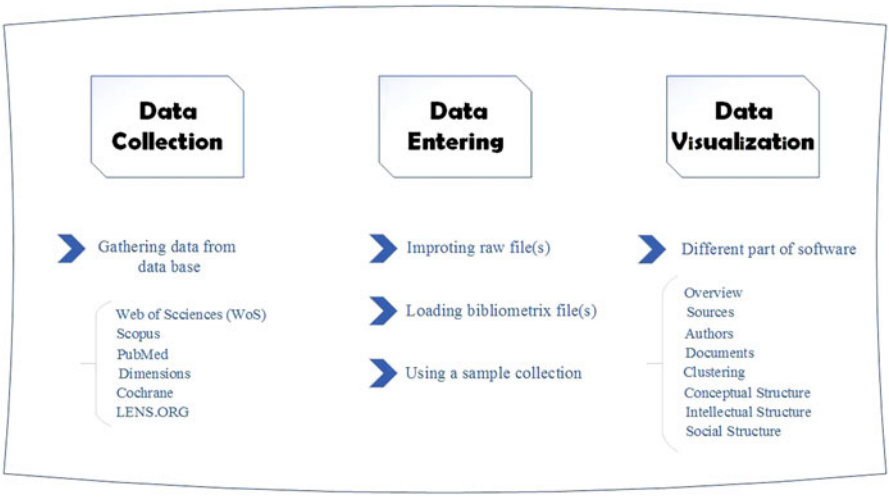

Fig. 1 Bibliometric research's steps through Biblioshiny

Data is the dynamic engine of bibliometric analysis. The clearer and more thorough our data, the more precise and accurate our results will be. According to Visser et al. (2021), "Bibliographical databases" are digital collections of references that are used to represent scientific literature in an orderly manner, such as journals, conference proceedings, patents, books, and more. In most cases, they include highly detailed descriptions of the topics covered in the form of keywords, subject categorization phrases, or abstracts. In Biblioshiny, raw files with the following formats can be imported to access major bibliometric databases: BIB, TXT, CIW, CSV, bibliometrix files: rdata, xls, and using sample collections. Bibliometric's numerous available methods make importing bibliographic information from Scopus, Clarivate Analytics' Web of Science, Dimensions, The Lens, PubMed, and Cochrane possible. Almost 36 million articles are available through the Web of Science (WoS), making it one of the most popular bibliographic databases. Scopus offers access to approximately 20 million articles. In terms of the quality of the data it contains, the Web of Science is superior to other databases (Aria et al. 2020; Harzing and Alakangas 2016). Despite the acceptable status of WoS metadata, three metadata items are completely missing from Scopus (Keywords Plus, Number of cited References, and Science Categories). Lastly, the data must be cleansed. In order for a calculation to be accurate, it must be based on data that is precise. A variety of pre-processing techniques can be employed, for example, to identify duplicates or misspellings. Although bibliometric data is generally reliable, there may be some discrepancies due to the fact that a single reference may include multiple editions of the same publication or different spellings of the author's name.

2 Data Gathering

To gather the information we need, combine a list of phrases and items in the search box that may be used to locate articles in the specific field that make use of some methods that connect with the Boolean operators ("AND", "OR", and "NOT"). Make sure that research is limited to the target area and related fields. Next, the time period will be defined. It is also essential for the user to determine which type of document will be analyzed (article, book chapter, book review, the editorial). There is a wide range of languages used in academic papers from which to choose depending on the specifics of our investigation.

The inclusion criteria of this bibliometric study adhered to PRISMA's guiding principles. The term PRISMA stands for preferred reporting items for systematic reviews and meta-analyses. It illustrates the process of screening in a visually appealing manner. Initially, the PRISMA records the number of articles that have been retrieved, and then it makes the selection process transparent by indicating the decisions made at different stages of the systematic review. At each stage, the number of articles is recorded. When excluding articles, researchers should include the reasons for doing so (Moher et al. 2009). The following eight WoS online indexing databases were chosen in accordance with the search strategy: Science

Metadata	Description	Scopus	Missing Counts	Missing %	Status
AB	Abstract		0	0.00	Excellent
C1	Affiliation		0	0.00	Excellent
AU	Author		0	0.00	Excellent
CR	Cited References		0	0.00	Excellent
DT	Document Type		0	0.00	Excellent
SO	Journal		0	0.00	Excellent
LA	Language		0	0.00	Excellent
PY	Publication Year		0	0.00	Excellent
TI	Title		0	0.00	Excellent
TC	Total Citation		0	0.00	Excellent
DI	DOI		11	6.01	Good
RP	Corresponding Author		16	8.74	Good
DE	Keywords		28	15.30	Acceptable
ID	Keywords Plus		183	100.00	Completely missing
NR	Number of Cited References		183	100.00	Completely missing
WC	Science Categories		183	100.00	Completely missing

Metadata	Description	WoS	Missing Counts	Missing %	Status
AU	Author		0	0.00	Excellent
CR	Cited References		0	0.00	Excellent
DT	Document Type		0	0.00	Excellent
SO	Journal		0	0.00	Excellent
LA	Language		0	0.00	Excellent
NR	Number of Cited References		0	0.00	Excellent
WC	Science Categories		0	0.00	Excellent
TI	Title		0	0.00	Excellent
TC	Total Citation		0	0.00	Excellent
C1	Affiliation		5	0.57	Good
RP	Corresponding Author		5	0.57	Good
AB	Abstract		29	3.29	Good
PY	Publication Year		73	8.29	Good
DE	Keywords		96	10.90	Acceptable
DI	DOI		126	14.30	Acceptable
ID	Keywords Plus		165	18.73	Acceptable

Fig. 2 Scopus and WoS metadata status

Citation Index Expanded (SCI), Social Sciences Citation Index (SSCI), Art and Humanities Citation Index (AHCI), Conference Proceedings Index – Science (CPCI-S), Conference Proceedings Citation Index – Social Science and Humanities (CPCI-SSH), Book Citation Index – Science (BKCI-S), Book Citation Index – Social Sciences and Humanities (BKCI-SSH), and Emerging Sources Citation Indexes (ESCI). Figure 2 depicts the PRISMA flow diagram utilized in the bibliometric study.

In the following query, only articles that meet the following criteria will be considered: ("Computer Assisted Language Learning" OR "CALL" OR "Mobile Assisted Language Learning" OR "MALL" OR "Robot Assisted Language Learning" OR "RALL") AND ("Applied Linguistics" OR "ESL" OR "EFL" OR "L2 English" OR "English as a Second Language" OR "English as a Foreign Language" OR "English Teaching") in the title, abstract or in the keyword list. Next, narrow the document topic to include only Language and Linguistics, Education and Educational Research. Ten years was chosen as the time frame for this bibliometric study (2013–2022). Therefore, only articles were selected as a document type. As a final step, English-language articles were included. Furthermore, a plain text data set was downloaded from WoS using the PRISMA flow diagram steps. According to the exclusion criteria, some records were extracted from plain text. A total of 881 articles relating to the English language and technology were analyzed in this study (Fig. 3).

3 Working with R Biblioshiny

To begin, install the most recent version of R (https://cran.r-project.org). Next, install the most recent version of Rstudio (https://rstudio.com). Having completed all these steps, open Rstudio and run the following commands in the top left window: (1) install.packages ("bibliometrix"), (2) library (bibliometrix), (3) bibliometrix:: biblioshiny (R Core Team 2014) (Figs. 4 and 5).

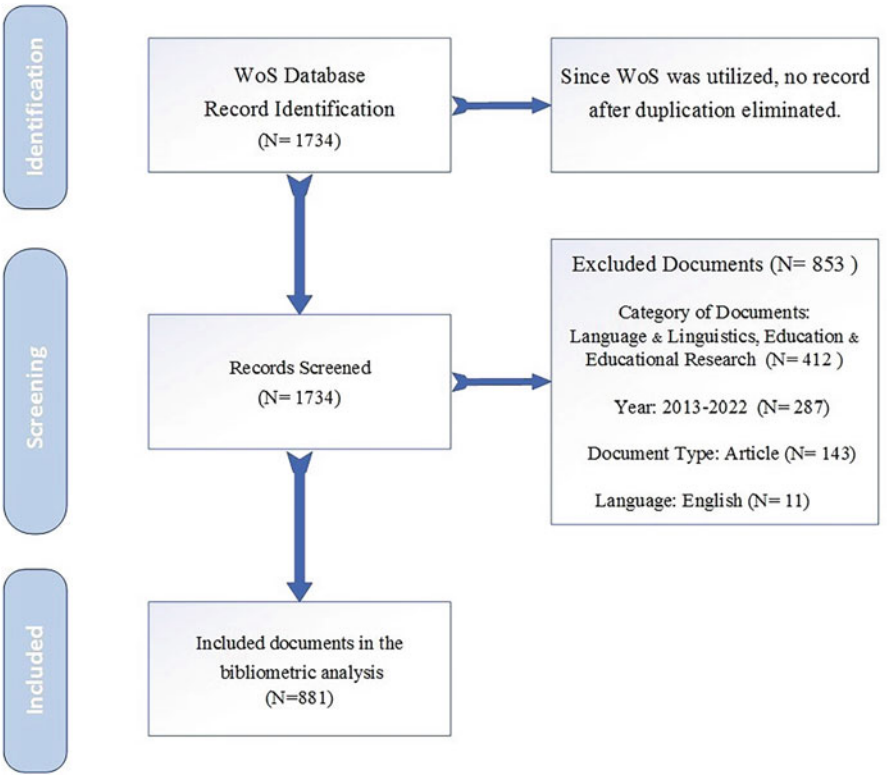

Fig. 3 PRISMA flow diagram

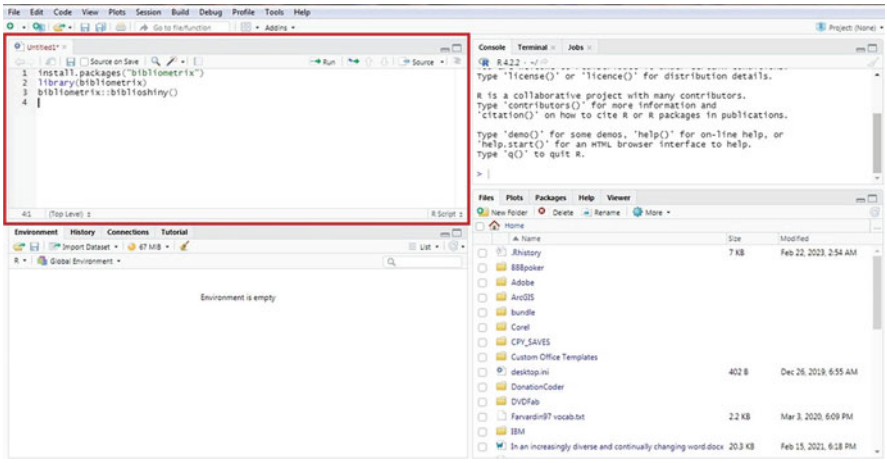

Fig. 4 Rstudio workplace

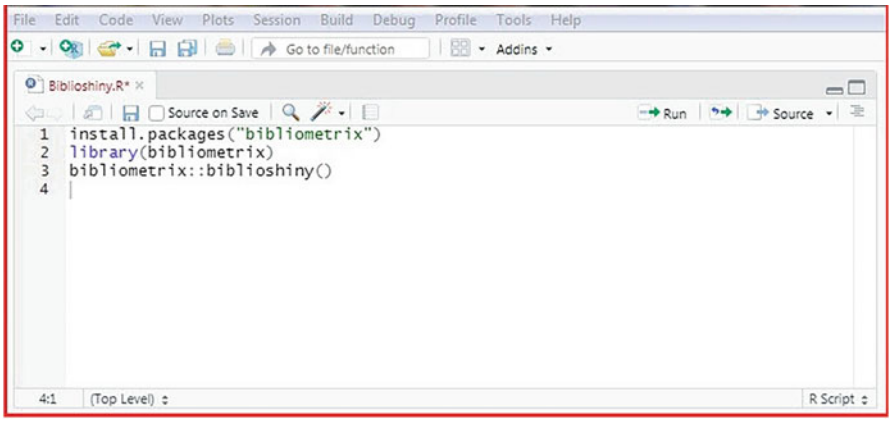

Fig. 5 Code editore

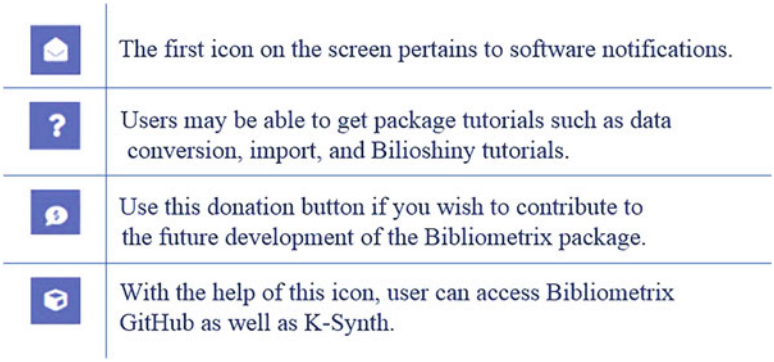

Fig. 6 Basic sittings of the Biblioshiny

Once run the program, you enter to graphical user interface (GUI) of the Bibioshiny. On the top right side are four basic icons, each of which is described individually (Fig. 6).

In addition, users can add the results of specific analyses into the Export section to obtain a CSV file. Meanwhile, it should be noted that in every section of Biblioshiny, a plus icon can be used to include the results in the report. Through the system settings, which is the last icon, the user can alter general modifications of software such as resolutions of export plots as PNG as well as changing height in inches. It is possible to alter general software settings through the system settings, which is the last icon. These adjustments include adjusting the resolution of export plots as PNGs as well as changing the height in inches. It is time to explore the Bibloshiny application. The first step is to select the data format used in the study. A raw data file, a bibliometric file, or a sample collection can be used in this format. Importing and loading files using Biblioshiny's APIs (Application Programming Interfaces) is

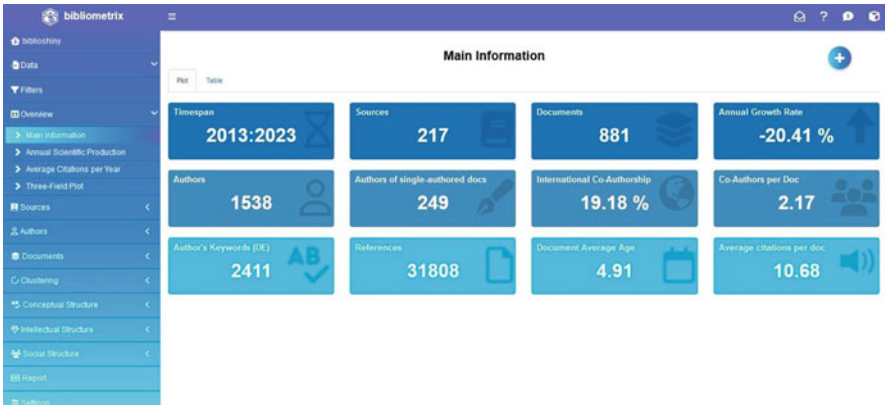

Fig. 7 Bibliometric data overview

also possible. Select the plain text file exported from WoS from the browse button, and then select "Web of Science (WoS/WoK)" as the database. Data from other databases, such as Scopus, PubMed, Lens.org, Dimensions, and Cochrane Library, can be analyzed. The number of documents will appear in the conversion results once the user clicks the start button. Figure 7 shows that 881 documents have been uploaded to the app with different information. An in-depth literature review of the study can be illustrated with Biblioshiny's user-friendly interface.

3.1 Overview

Figure 7 shows the most important information about the documents in the boxes. A total of 881 articles were included in the study from 217 sources between 2013 and 2022. There were 881 articles related to the English language and technology written by 1538 authors. One author wrote 249 articles. The average number of citations per document was 10.68. Biblioshiny also offered the option to download each plot in multiple formats (CSV, Excel, PDF) and different resolutions. The plots can be exported in a resolution ranging from 75 dpi to 600 dpi.

According to Fig. 8, the highest number of publications was published in 2022 ($N = 120$). The number of documents produced during this period has fluctuated since 2013. Besides, graphs generated with Plotly are all dynamic, so you can see more information by moving your mouse over them (Table 1).

The user can get a graph illustrating the rate of citations over 10 years by clicking on the average citation per year button. Interestingly, the average number of citations per year in 2019 is the highest rate, indicating that one or more articles published in 2019 received the most citations ($N = 2.39$) (Fig. 9 and Table 2).

Three-field plots can be selected based on the objective of the researchers by choosing from authors, affiliations, countries, keywords, abstracts, references, and

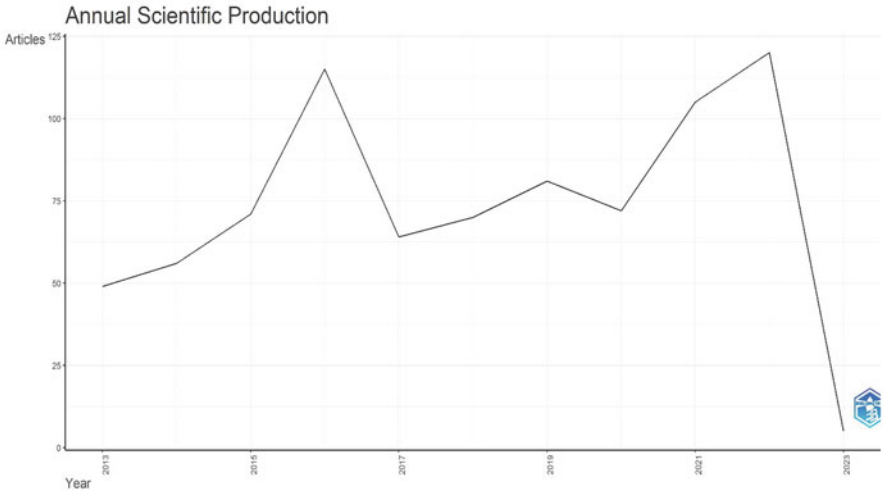

Fig. 8 Citations per year for articles

Table 1 Articles published annually

Years	Articles
2013	49
2014	56
2015	71
2016	115
2017	64
2018	70
2019	81
2020	72
2021	105
2022	120

cited sources in accordance with their objectives. Determining the variables and number of items in the middle, left, and right fields is necessary. Upon setting these conditions, clicking the apply button will produce the plot. In order to create it, three meta-data fields must be selected. In this bibliometric study, the author occupied the middle field, the country occupied the left field, and the keywords occupied the right field (Fig. 10).

3.2 Sources

The y-axis shows the number of journals and sources that have published at least one of the documents in the bibliometric repertoire, while the x-axis shows the total number of articles published. Computer Assisted Language Learning (N = 226) was

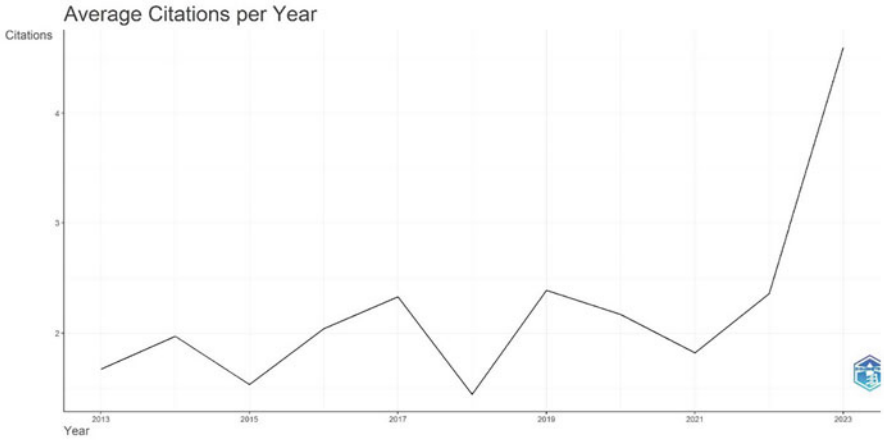

Fig. 9 Citations per year for articles

Table 2 Annual total citation per year

Year	MeanTCperArt	N	MeanTCperYear	CitableYears
2013	**18.41**	**49.00**	**1.67**	**11**
2014	**19.7**	**56.00**	**1.97**	**10**
2015	**13.76**	**71.00**	**1.53**	**9**
2016	**16.3**	**115.00**	**2.04**	**8**
2017	**16.33**	**64.00**	**2.33**	**7**
2018	**8.66**	**70.00**	**1.44**	**6**
2019	**11.94**	**81.00**	**2.39**	**5**
2020	**8.67**	**72.00**	**2.17**	**4**
2021	**5.45**	**105.00**	**1.82**	**3**
2022	**4.72**	**120.00**	**2.36**	**2**

the most commonly published journal in this research, International Journal of Computer-assisted Language Learning and Teaching (N = 66), System (N = 30), and Language Learning and Technology (N = 28). Arab World English Journal and RECALL (N = 25). Users may find it useful to click on the options button at the top of the page to find an option that allows them to add more sources to the list (Fig. 11 and Table 3).

Bradford's law categorizes articles and journals to identify the relevant number for each topic. Its calculation is based on the sum of articles published by journals in a specific field of study. By doing so, it is possible to identify the core of the journals, which can then be used to analyze the core zone documents. Bradford defined the first zone as the center of specialized journals. In addition, Bradford's law is also suitable for classifying journals based on their number of citations. It can be concluded that a relatively small number of journals produce a substantial amount of high-quality science based on citations (Fig. 12).

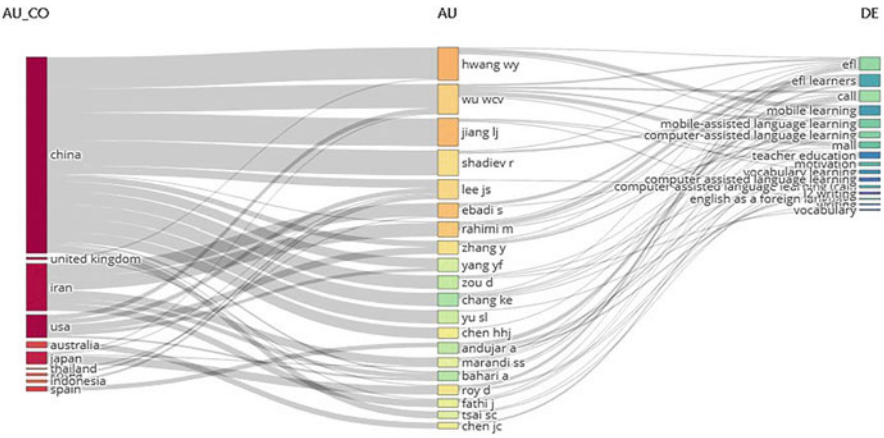

Fig. 10 Three-field plot

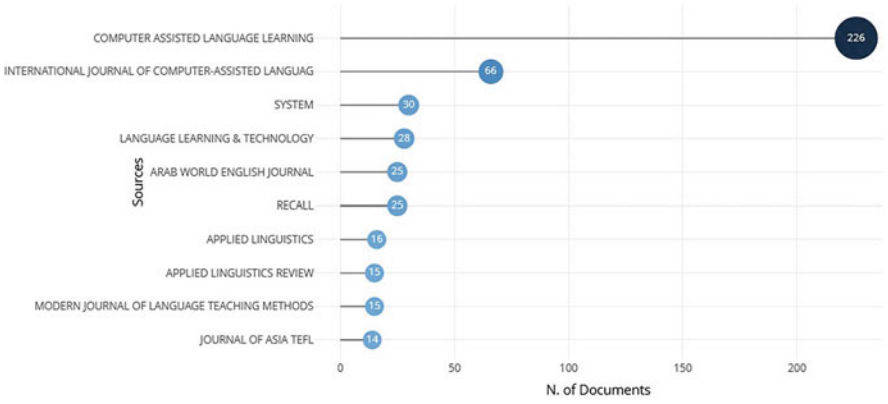

Fig. 11 Most relevant sources

Computer-Assisted Language Learning Journal and International Journal of Computer Assisted Language Learning and Teaching are two of the core zones among the 217 journals. Consequently, two journals with 292 articles are in the core zone, 26 journals with 301 articles are in the middle zone, and 189 journals with 282 articles are in the minor core (Fig. 13).

The H-index, also known as the Hirsch index, is the number of an author's or journal's works that have been mentioned in at least one other piece of research. Hence, this index is a more refined version of basic metrics like overall publications or citation counts. The index works best when comparing researchers in the same area due to the large variation in publications across fields. For example, if seven articles from a researcher's total publication are cited at least seven times in other articles, the H-index of that researcher is seven. Therefore, The H-index is considered the consequence of the equilibrium between articles and citations. In addition to

Table 3 Journal article publication rate

Sources	Articles
COMPUTER ASSISTED LANGUAGE LEARNING	266
INTERNATIONAL JOURNAL OF COMPUTER-ASSISTED LANGUAGE LEARNING AND TEACHING	66
SYSTEM	30
LANGUAGE LEARNING AND TECHNOLOGY	28
ARAB WORLD ENGLISH JOURNAL	25
RECALL	25
APPLIED LINGUISTICS	16
APPLIED LINGUISTICS REVIEW	15
MODERN JOURNAL OF LANGUAGE TEACHING METHODS	15
JOURNAL OF ASIA TEFL	14

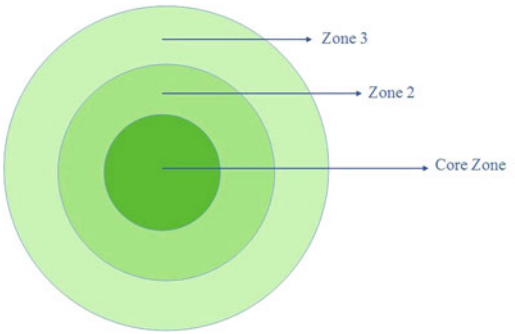

Fig. 12 Bradford's law zone

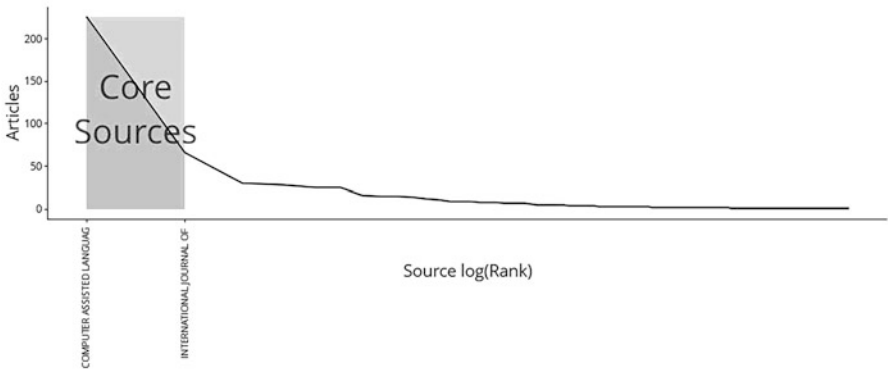

Fig. 13 Bradford's law core sources

other science measurement indices, such as the number of publications and citations, this index distinguishes influential researchers from those who produce many articles. The m-index is calculated by dividing the scientist's H-index by the number of years (n) from his or her first publication (journal).

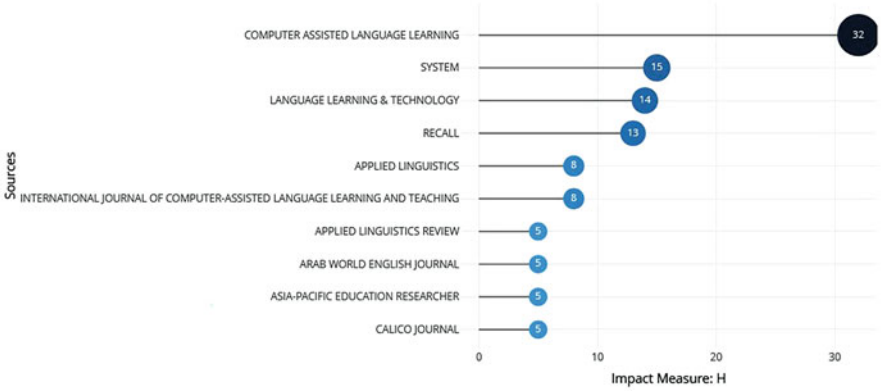

Fig. 14 The local impact of journals by H-index

Table 4 Information on local impacts of journals

Sources	h-index	g-index	m-index	TC	NY	PY-start
COMPUTER ASSISTED LANGUAGE LEARNING	32	46	–	3709	226	–
SYSTEM	15	23	1.364	581	30	2013
LANGUAGE LEARNING AND TECHNOLOGY	14	25	1.273	657	28	2013
RECALL	13	21	1.182	468	25	2013
APPLIED LINGUISTICS	8	16	0.800	625	16	2014
INTERNATIONAL JOURNAL OF COMPUTER-ASSISTED LANGUAGE LEARNING AND TEACHING	8	12	0.727	245	66	2013
APPLIED LINGUISTICS REVIEW	5	12	–	159	15	–
ARAB WORLD ENGLISH JOURNAL	5	7	0.455	72	25	2013
MODERN JOURNAL OF LANGUAGE TEACHING METHODS	5	7	–	50	8	–
CALICO JOURNAL	5	8	0.455	66	9	2013

Compared to the H-index, the g-index is superior as a worldwide indicator of an article's citation impact. If sorted from most to least citations, the g-index is the (unique) greatest number such that the top g articles received (collectively) at least g2 citations. Taking into account source local impact by H index, Computer Assisted Language Learning (H-index = 32), System (H-index = 15), Language Learning and Technology (H-index = 14), and RECALL (H-index = 13) were ranked in that order (Fig. 14 and Table 4).

The user will find the publications on the left, while developments for each year can be seen on the right. The number of articles related to English Language and Technology has increased for each journal since 2012. The graph shows that

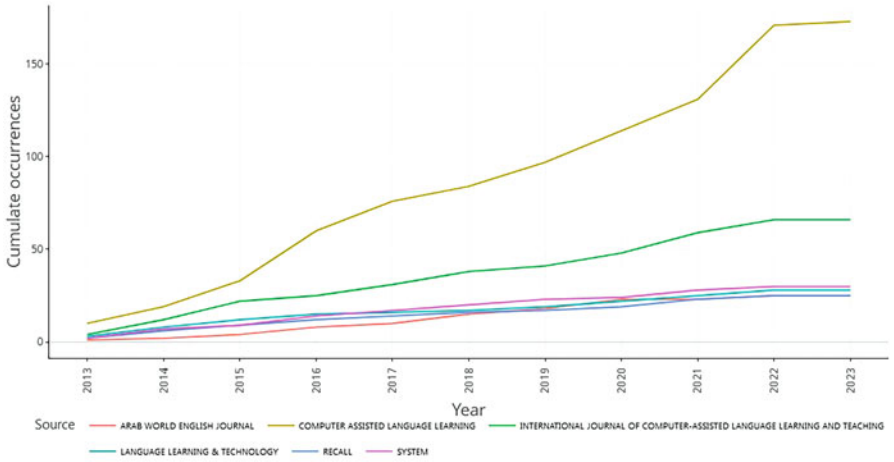

Fig. 15 Production of journals over time

Computer Assisted Language Learning Started with ten articles in 2013 and reached the highest number among other journals in 2022 (N = 171) (Fig. 15 and Table 5).

3.3 Authors

This section aims to illustrate bibliometric analysis through information about authors, such as the most relevant authors, most locally cited authors, top authors' production over time, Lotka's law, and authors' local impact. In regards to affiliations, the most relevant affiliations will be discussed along with their production over time. Furthermore, a bibliometric analysis of countries will be performed, including the corresponding authors' countries, the scientific output of countries, the countries' production over time, and the most cited countries. The following plots (Figs. 16 and 17) and Tables (6 and 7) illustrate the development of an author's publications and citations over time. In plots 16 and 17, it can be seen that HWANG WY had the highest number of publications (N = 11) and citations (N = 65).

Figure 18 illustrates the development of authors' production over time. The circle will likely be darker and larger if you have published more articles than in other years. As an example, LEE JS had 4 publications in 2019 and an average of 22 citations per year. As the number of documents increases, the bubble size increases. Color intensity is directly proportional to the number of citations per year and the number of citations per year. There were 3 articles authored by RAHIMI, M in 2022, and the number of citations he received per year was 22.5. The light pink line indicates the authors' timeline. Among all the ten-year activities, HWANG WY has the longest timeline (2013–2022).

Table 5 Annual production overview

Year	COMPUTER ASSISTED LANGUAGE LEARNING	INTERNATIONAL JOURNAL OF COMPUTER-ASSISTED LANGUAGE LEARNING AND TEACHING	SYSTEM	LANGUAGE LEARNING &TECHNOLOGY	ARAB WORLD ENGLISH JOURNAL	RECALL
2013	10	4	2	3	1	2
2014	19	12	7	8	2	6
2015	33	22	9	12	4	9
2016	60	25	14	15	8	12
2017	76	31	17	16	10	14
2018	84	38	20	17	15	16
2019	97	41	23	19	18	17
2020	114	48	24	22	23	19
2021	131	59	28	25	23	23
2022	171	66	30	28	25	25

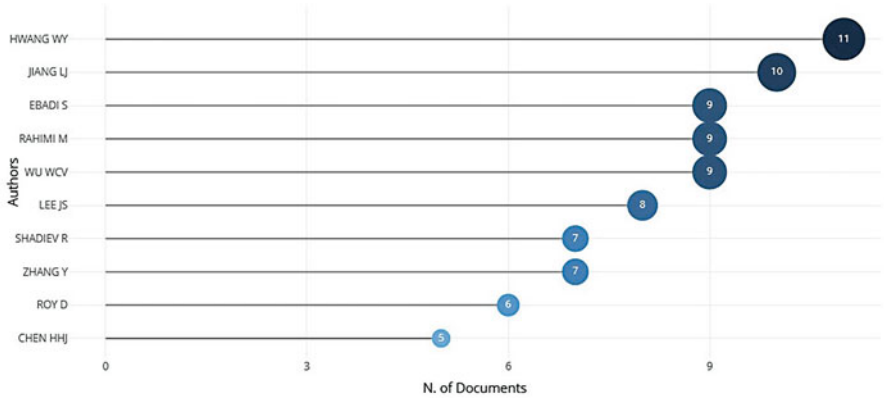

Fig. 16 Most relevant authors

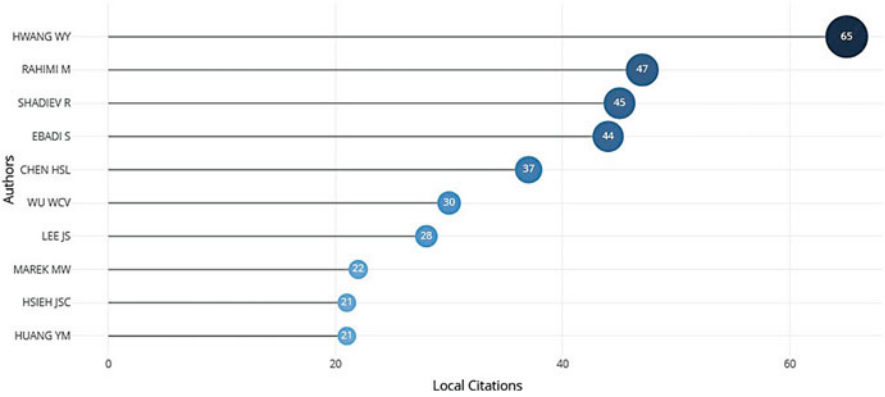

Fig. 17 Most locally cited authors

Table 6 The number of articles per author

Authors	Articles	Articles Fractionalized
HWANG WY	11	2.88
JIANG LJ	10	4.58
EBADI S	9	4.00
RAHIMI M	9	4.25
WU WCV	9	3.50
LEE JS	8	5.33
SHADIEV R	7	1.90
ZHANG Y	7	5.33
ROY D	6	4.83
CHEN HHJ	5	2.58

Table 7 Citation information of authors

Author	Local Citations
HWANG WY	65
RAHIMI M	47
SHADIEV R	45
EBADI S	44
CHEN HSL	37
WU WCV	30
LEE JS	28
MAREK MW	22
HSIEH JSC	21
HUANG YM	21

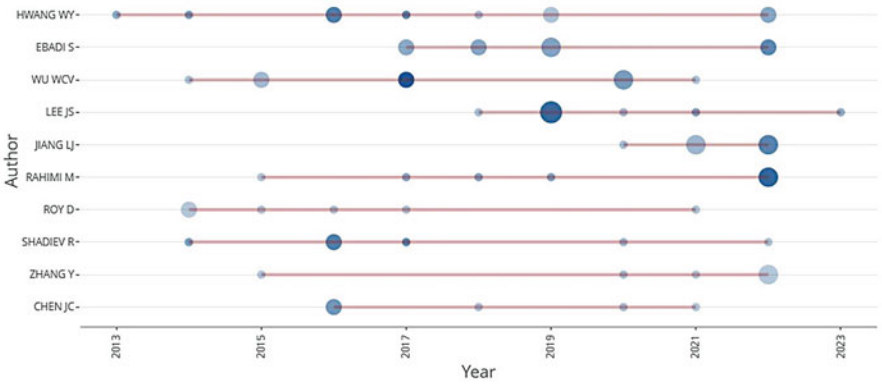

Fig. 18 Production of authors over time

Lotka's law describes the frequency of publication by authors in different fields. There is a fixed ratio between the number of authors publishing a certain number of articles and the number of authors publishing a single article. Lotka's law can be mathematically represented using a formula showing how it works. Where A represents the number of publications, B is the relative frequency of authors with A publications, n and C are constants that vary depending on the field ($n \approx 2$).

$$A^n B = C$$

Lotka's law states that as the number of articles published increases, the number of authors who produce many publications will decrease. A total of 1321 authors (85.1%) have only published one article. This baseline represents authors who have published more than one article, which reveals that 142 authors (0.1%) have 2 publications. Based on this baseline, which represents the number of core authors who have published at least two articles, it can be seen that 142 authors (0.1%) have published at least two articles. On the other hand, the term occasional authors refers

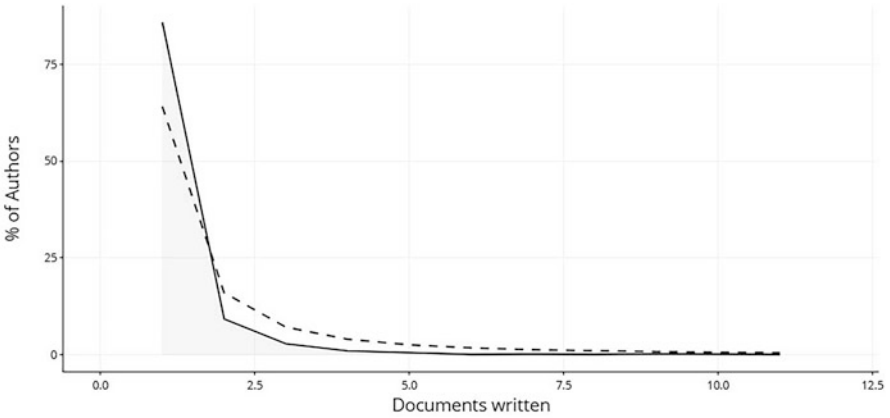

Fig. 19 Lotka's law of author productivity

Table 8 Author productivity based on Lotka's law

Documents Written	N. of Authors	Proportion of Authors
1	**1321**	**0.859**
2	**142**	**0.092**
3	**43**	**0.028**
4	**15**	**0.010**
5	**8**	**0.005**
6	**1**	**0.001**
7	**2**	**0.001**
8	**1**	**0.001**
9	**3**	**0.002**
10	**1**	**0.001**
11	**1**	**0.001**

to 1321 authors who have published only one publication (86%) (Fig. 19 and Table 8).

According to Fig. 20, authors are categorized based on the H-index of their publications. Three authors (EBADI S, HWANG WY, LEE JS) in the top tier have recorded an H-index of 7.

3.3.1 Affiliations

As found in this bibliometric analysis, the majority of the authors were from Islamic Azad University in Iran (N = 36), National Taiwan Normal University in China (N = 26), Education University in Hong Kong (N = 20), and Iowa State University in the USA (N = 19) (Fig. 21 and Table 9).

As shown in Fig. 22, the production of the affiliation has increased over time. Iowa State University, among other affiliations, had the highest rate (N = 5) in 2013,

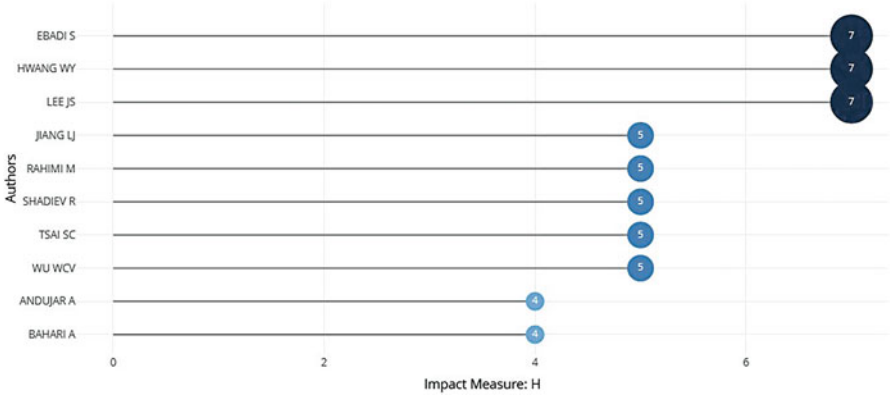

Fig. 20 Local impact of authors

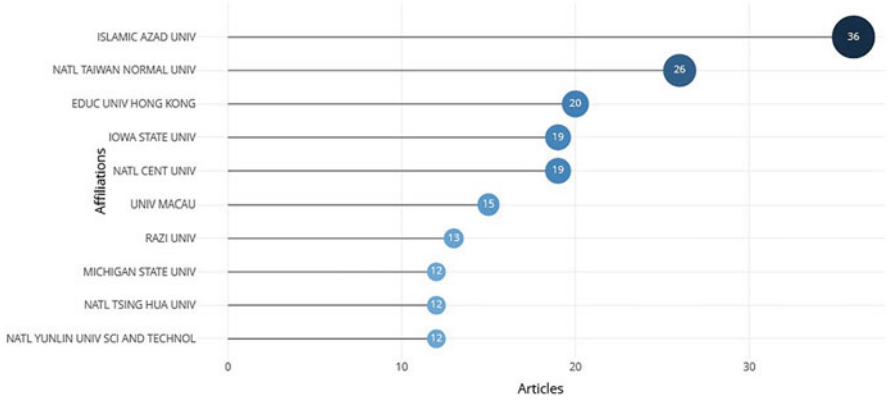

Fig. 21 Highly affiliated institution

Table 9 Institutional rate of publication

Affiliation	Articles
ISLAMIC AZAD UNIV	**36**
NATL TAIWAN NORMAL UNIV	**26**
EDUC UNIV HONG KONG	**20**
IOWA STATE UNIV	**19**
NATL CENT UNIV	**19**
UNIV MACAU	**15**
RAZI UNIV	**13**
MICHIGAN STATE UNIV	**12**
NATL TSING HUA UNIV	**12**
NATL YUNLIN UNI SCI AND TECHNOL	**12**

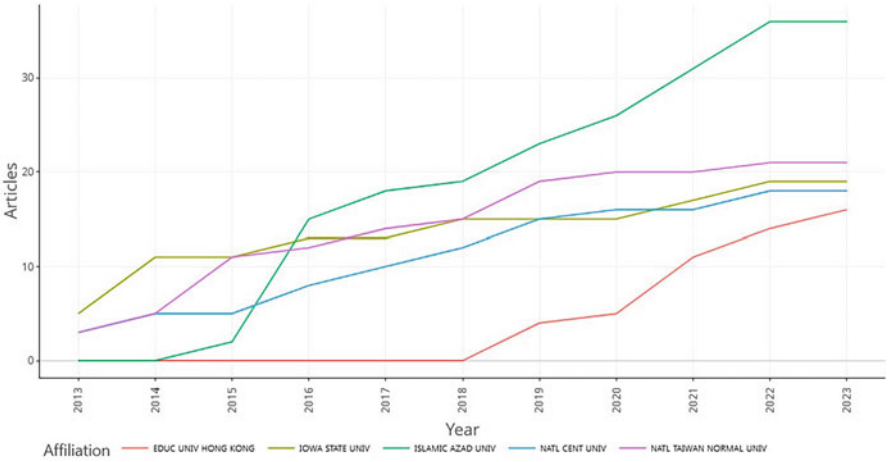

Fig. 22 Production over time by institutions

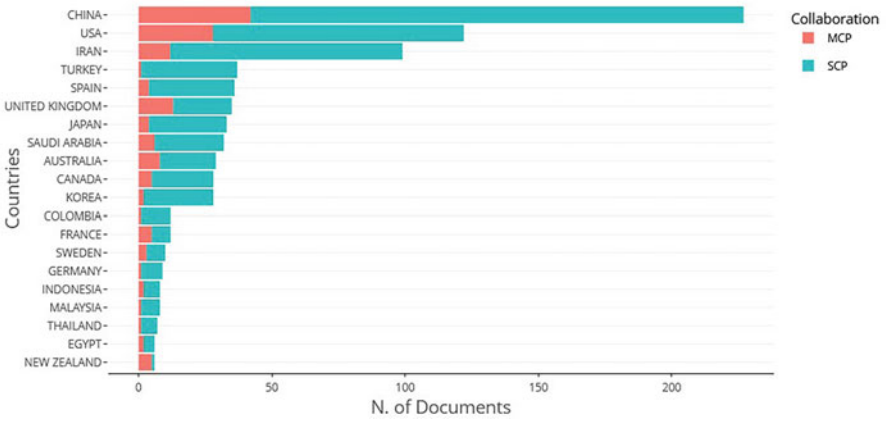

Fig. 23 Countries of corresponding authors

whereas Islamic Azad University, which has been growing steadily over the years, hit peak levels in 2022 (N = 36).

3.3.2 Countries

According to Fig. 23, the authors' countries of the articles were given, the corresponding authors' countries indicated multiple country publications (MCPs), and the turquoise bar indicated single country publications (SCP). Accordingly, MCP indicates for each country the number of documents in which at least one coauthor is from another country. MCP measures a country's international

Table 10 Information on corresponding authors' countries

Country	Articles	SCP	MCP	Freq	MCP-Ratio
CHINA	227	185	42	0.258	0.185
USA	122	94	28	0.138	0.230
IRAN	99	87	12	0.112	0.121
TURKEY	37	36	1	0.042	0.027
SPAIN	36	32	4	0.041	0.111
UNITED KINGDOM	35	22	13	0.040	0.371
JAPAN	33	29	4	0.037	0.121
SAUDI ARABIA	32	26	6	0.036	0.188
AUSTRALIA	29	21	8	0.033	0.276
CANADA	28	23	5	0.032	0.179

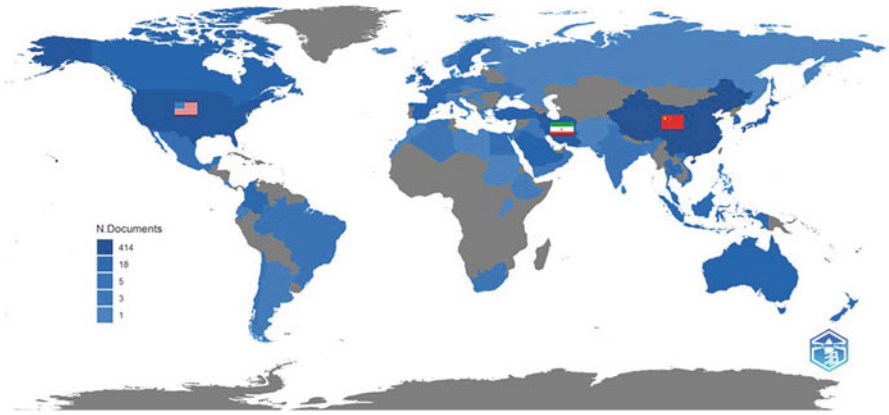

Fig. 24 Scientific production of the world

collaboration intensity. There were 227 corresponding authors from China. There is a total of 200 authors from the United States and 99 from Iran. However, most of the authors' collaborations were limited to contributions from a single country. New Zealand had a high level of international collaboration (N = 6, MCP = 5) (Table 10).

Every author's nationality contributed to the anthology is considered in this map. There is a direct correlation between the number of articles and the magnitude of the color. As the number of documents increases, the color of countries will be darker. For instance, with 414 documents, China is darker than India, with five documents. Moreover, the USA and Iran, which had a darker color than other countries, were the two countries that ranked second and third after China in terms of the frequency of publications (Fig. 24 and Table 11).

Let's take a closer look at the results of our study regarding countries' production since 2013, where China (N = 344) was the leading country, the USA, with

Table 11 Frequency of publication per country

Region	Freq
CHINA	414
USA	226
IRAN	146
TURKEY	75
SPAIN	66
UNITED KINGDOM	58
JAPAN	57
SAUDI ARABIA	54
AUSTRALIA	51
CANADA	46

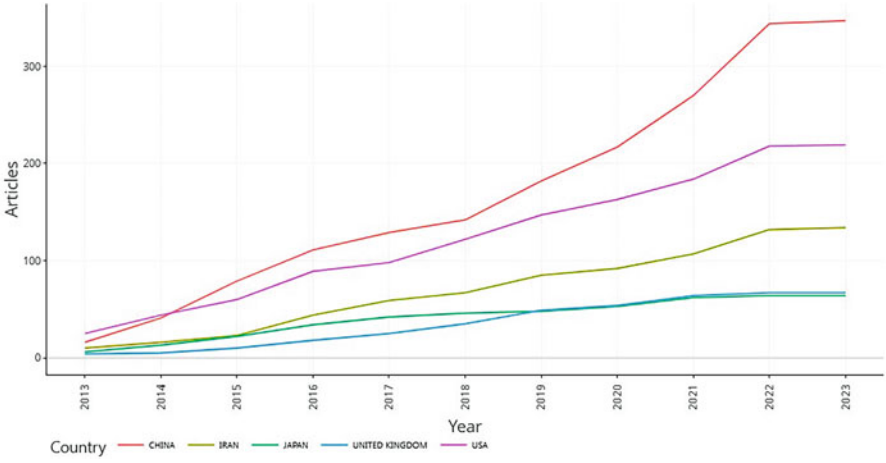

Fig. 25 Country production over time

218 documents, was the second country, and Iran (N = 132) was chasing them as the third (Fig. 25).

The most cited countries were China (N = 2962), the USA (N = 1547), Iran (N = 719), and Spain (N = 641), respectively. Although the total number of citations in New Zealand, which is in the twelfth place, was approximately one-seventeenth of that of the leading country, China, the average number of article citations in New Zealand had the highest value with 28.67 (Fig. 26 and Table 12).

3.4 Documents

The next section of the software will provide insight into some of the interesting features of the Biblioshiny by analyzing documents such as documents with the greatest local and global citations, references with the greatest local citations,

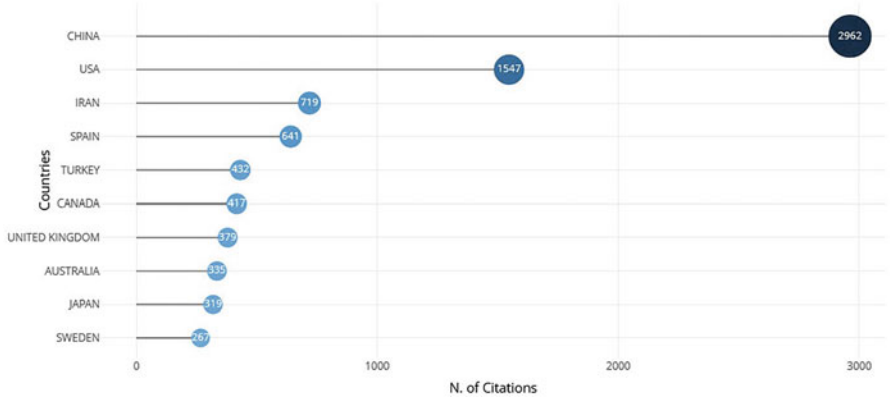

Fig. 26 Frequently cited countries

Table 12 Information on countries' citation

Country	TC	Average Article Citation
CHINA	**2962**	**13.05**
USA	**1547**	**12.68**
IRAN	**719**	**7.26**
SPAIN	**641**	**17.81**
TURKEY	**432**	**11.68**
CANADA	**417**	**14.89**
UNITED KINGDOM	**379**	**10.83**
AUSTRALIA	**335**	**11.55**
JAPAN	**319**	**9.67**
SWEDEN	**269**	**26.70**

reference spectrums, the most frequently used words, a word cloud, a tree map, and the frequency of words over time are all displayed (Fig. 27).

3.4.1 Cited References

Cenoz J.'s 2014 masterwork in the journal *Applied Linguistics* garnered the highest number of citations globally (N = 260). Additionally, the article published by HWANG WY in the Computer Assisted Language Learning journal received the most local citations in 2013 (N = 20). Furthermore, the global Citation metric measures the number of citations a document has received from all documents in the database (e.g., WoS or Scopus). Global citations indicate a document's impact across the entire bibliographic database. For many documents, a significant portion of global citations may originate from a discipline other than the one in which the document is published. In contrast, local citations are a document's citations from the studied collection.

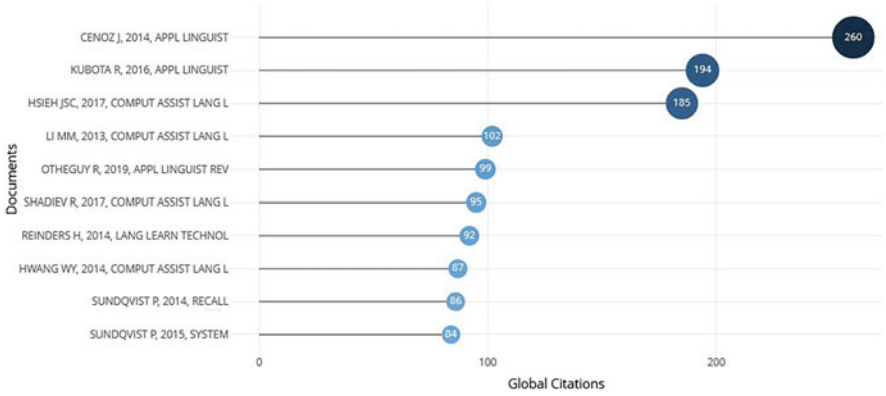

Fig. 27 Documents with global citation

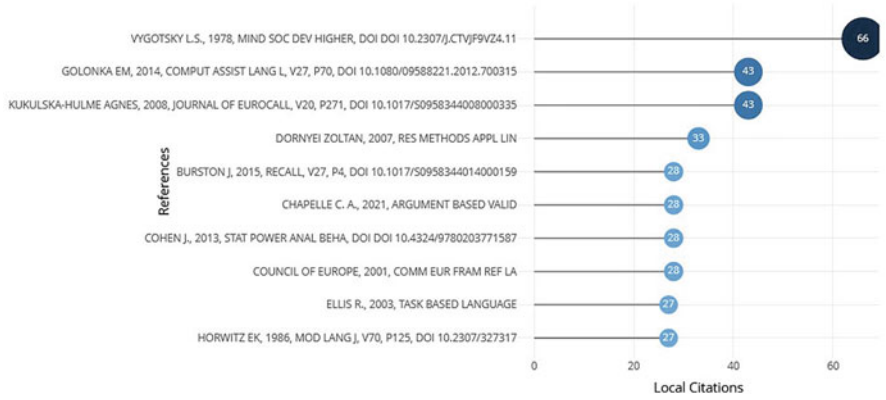

Fig. 28 The most cited local references

Similarly, the following figure illustrates the local references that have received the most citations. With 66 citations, VYGOTSKY L.S., 1978, Mind in Society: Development of Higher Psychological Processes, had the highest number of local citations. The second place went to GOLONKA, EM et al. for their computer-assisted language learning work with 43 citations (Fig. 28).

A method for determining the historical roots of research themes and topics is known as Reference Publication Year Spectroscopy (RPYS). RPYS highlights years with important findings in a paper's cited reference profile. By doing so, it is possible to identify the historical roots of a discipline (Marx et al. 2014). A black line represents the number of citations per year, while a red line represents deviations from the median over the past 5 years (Fig. 29).

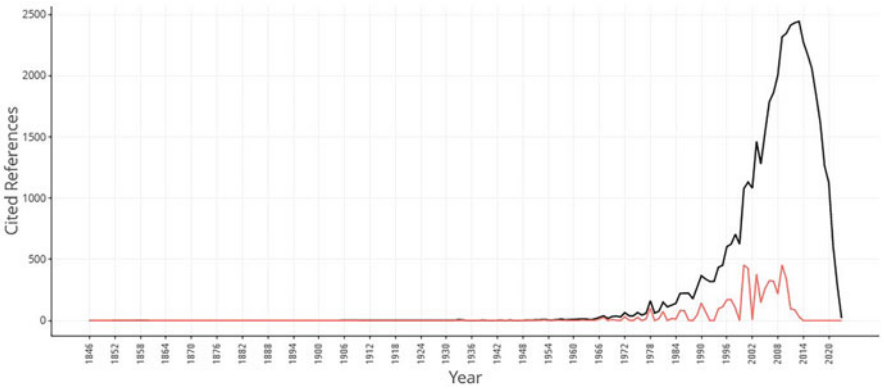

Fig. 29 Reference publication year spectroscopy

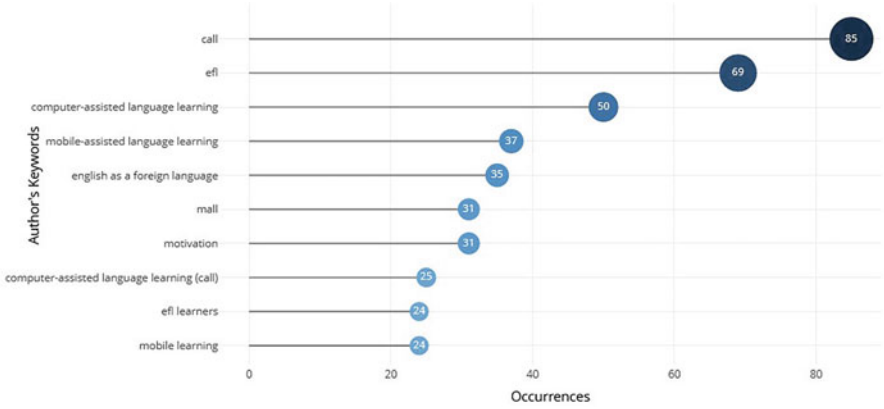

Fig. 30 Most frequent keywords

3.4.2 Words

If the user conducts keyword analysis, he or she may encounter some irrelevant words, such as conjunctions, adverbs, and plurals, that are irrelevant to the search. However, it is possible to eliminate words with the help of Bibliometrix for the time being. This issue can be avoided by creating a stop word list and uploading a TXT or CSV file that contains the words the user wishes to remove. Commas or semicolons should be used to separate or arrange items on a table. Additionally, margination analysis is plausible when plausible. This method is similar to the previous one: upload a synonym list in TXT or CSV format. Please note that the first word in the list will be replaced with the following (Fig. 30).

CALL was the most frequent word, with 85 occurrences, followed by EFL (N = 69) and Computer-assisted language learning (N = 50) in the top three most

Fig. 31 WordCloud derived from keywords

frequent words. Various parts of the document may contain keywords that can be extracted and analyzed.

In WordCloud, the top keyword plus, subject categories, author keywords, title, and abstract words are displayed. Additionally, by adjusting parameters in the options, we are able to change some default settings, such as the shape, font type, and font color. Different scale transformations can be selected for a more vivid picture of word distribution, such as frequency, square root, log, and log10 (Fig. 31).

TreeMap uses color blocks to display how frequently different words occur visually. In a similar vein, you may analyze the title, abstract, and keywords of a document. Based on the results of TreeMap, we identified concepts such as CALL (N = 85, 10%), EFL (N = 69, 8%), computer-assisted language learning (N = 50, 6%), mobile-assisted language learning (N = 37, 4%), and English as a foreign language (N = 35, 4%) (Fig. 32).

It is possible to determine the most frequent word, year, and frequency by passing the mouse over the graph. The term "CALL" had 5 times the frequency at the beginning of the study, and by the end of 2022, it had increased to 83 times the frequency. In the beginning, there were similar occurrences of computer-assisted language learning and EFL concepts (N = 5), but EFL reached 64, and computer-assisted language learning was ranked third with 48 occurrences (Fig. 33).

Trend-topic graphs are scatter diagrams in which the x-axis represents time, and the y-axis represents the topic. Each topic's reference year is determined based on the median of occurrences during the period considered. On the graph, each bubble represents a topic. There is a direct correlation between the size of the bubble and the number of occurrences of the words. Thus, the bubble's size indicates the term's frequency and the length of the lines indicates how long it has been studied (Fig. 34).

Fig. 32 TreeMap derived from keyword

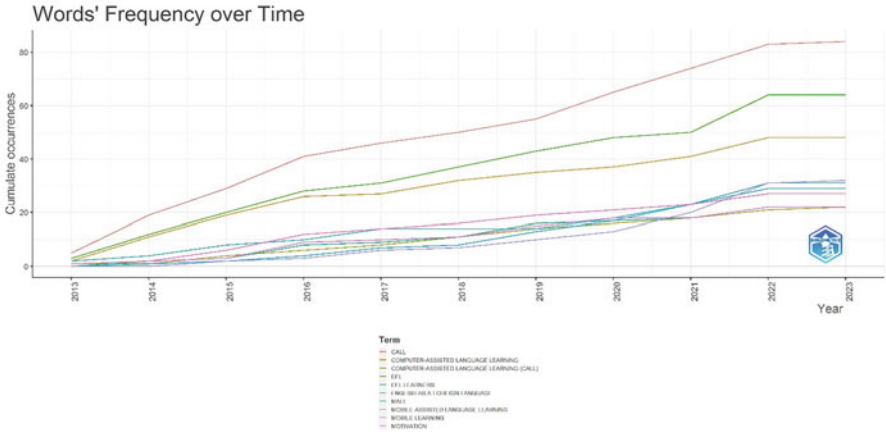

Fig. 33 Frequency of words over time

The author's keyword indicates that English as a foreign language has been a trending topic. Based on the analysis, the other trending topics were English as a foreign language, computer-assisted language learning, and CALL.

3.5 Clustering

The concept of bibliographic coupling can be viewed as the opposite of co-citation. In other words, it refers to a relationship between two or more documents that cite one another. Bibliographic coupling assumes that two documents can be significantly correlated even if they do not directly cite each other. Assuming that the two documents share at least one bibliographic reference, this is a reasonable

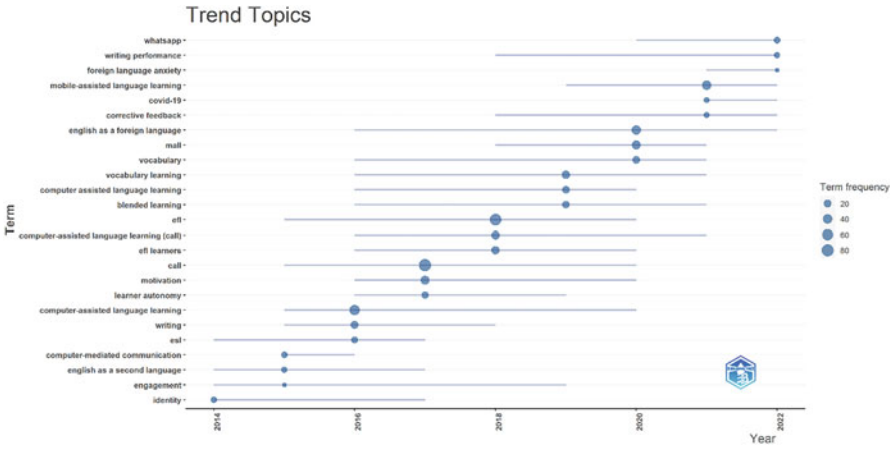

Fig. 34 Trends topic based on author's keyword

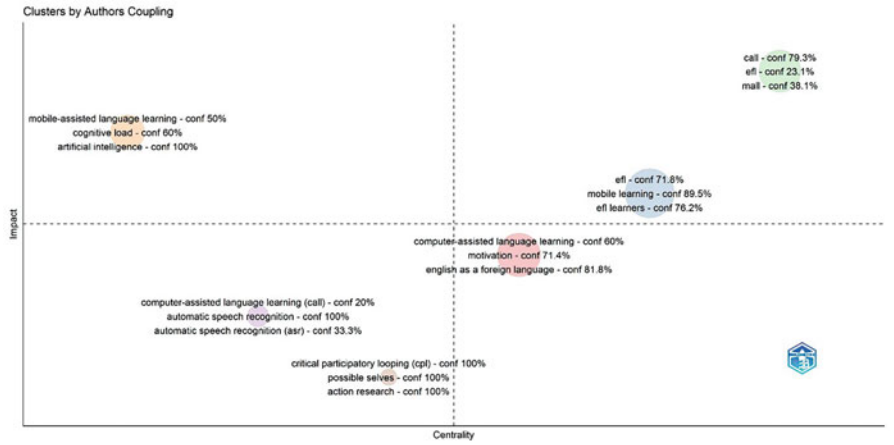

Fig. 35 Clustering by authors' coupling

assumption. Based on their symmetrical alignment and similar references, these documents are similar. The next few figures will illustrate how network clustering, maps, and clusters work by coupling them. It should be noted that some parameters can be altered based on our bibliographic needs, such as the units of analysis (documents, authors, sources), the impact of measures (local citation score, global citation score), and attributes (cluster labeling, coupling measure) (Figs. 35 and 36 and Table 13).

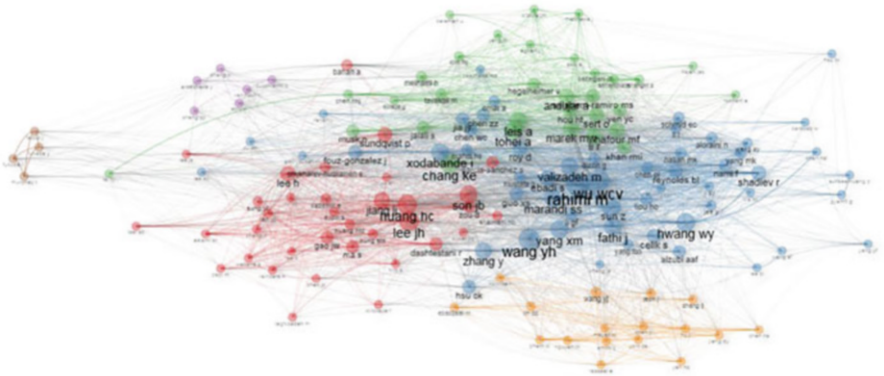

Fig. 36 Network map based on authors

Table 13 Information of clusters based on keywords

Label	Group	Freq	Centrality	Impact	Color
Computer-assisted language learning – conf 60% motivation – conf 71.4% English as a foreign language – conf 81.8%	1	35	0.59	1.73	#E41A1C80
EFL – conf 71.8% mobile learning – conf 89.55% EFL learners – conf 76.2%	2	56	0.74	1.78	#377 EB880
call – conf 79.3% EFL – conf 23.1% mall – conf 38.1%	3	32	0.78	2.45	#4DAF4A80
Computer-assisted language learning (CALL) – conf 20% automatic speech recognition – conf 100% automatic speech recognition (ASR) – conf 33.3%	4	6	0.43	1.43	#984EA380
Mobile-assisted language learning – conf 50% cognitive load – conf 60% artificial intelligence – conf 100%	5	17	0.43	1.90	#FF7F0080
Critical participatory looping (CPL) – conf 100% possible selves – conf 100% action research – conf 100%	6	4	0.58	0	#A6562880

3.6 Conceptual Structure

This conceptual structure establishes a map of the scientific field by assessing correspondences, multiple correspondences, and clustering of terms in a 2-dimensional network using a vertices network of terms obtained from the keyword, title, and abstract fields (Hubert 1980). Also, it is composed of three main parts: a co-occurrence network, a thematic map, and a thematic evolution chart. The probable link between two bibliographic items appearing in the same research is evaluated in co-occurrence network analysis. Figures 45 and 46 illustrate the co-occurrence network and degree plot analysis of the author's keyword. According to the size of the bubbles in the figure, CALL, EFL, and computer-assisted language

learning are the most frequent keywords, ranked accordingly, as well as in the degree plot diagram (Figs. 37 and 38).

According to the thematic map, there were a total of 12 clusters identified. Based on the author's keywords, the basic (developing) themes were (English, language, student), (call, knowledge, communication), and (competence, second-language acquisition, and negotiation). Modality was an emerging or declining theme. In terms of the motor (developed) theme, no parameters were available. Among the niche topics that were covered were (ESL, world English), (Japanese, words, speech perception), (organization, repair, conversation analysis), (attention, discourse, patterns), and (technology acceptance). A few invariance clusters are located between two of the basic quadrants and the motor quadrants, such as (technology, education, performance) and (accuracy, complexity, and performance). The video, input, and environment clusters were also located among the basic, motor, and emerging themes (Fig. 39).

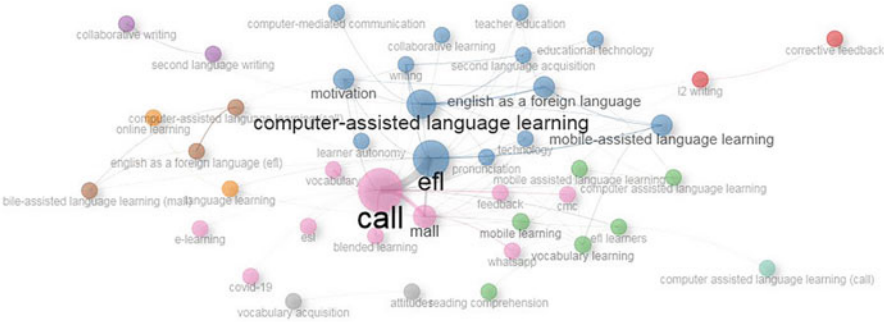

Fig. 37 Co-occurrence network based on keywords

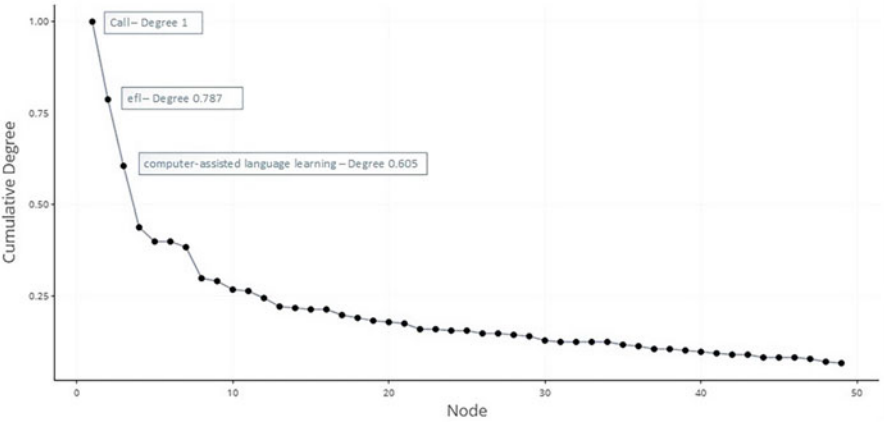

Fig. 38 Degree plot of co-occurrence network based on keywords

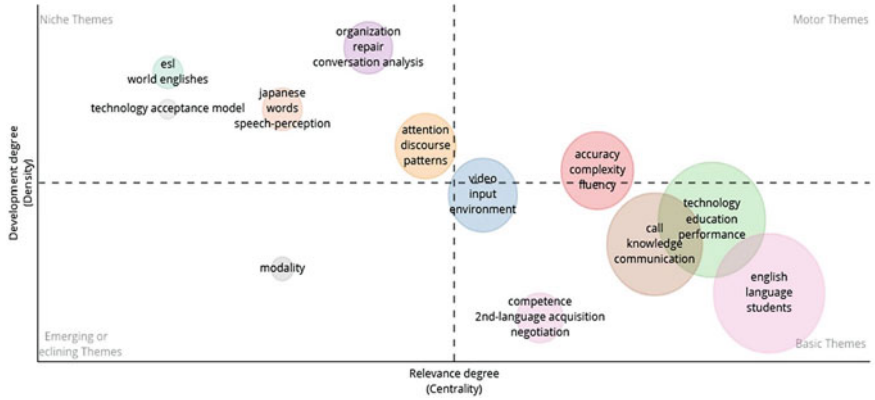

Fig. 39 Thematic map of keywords

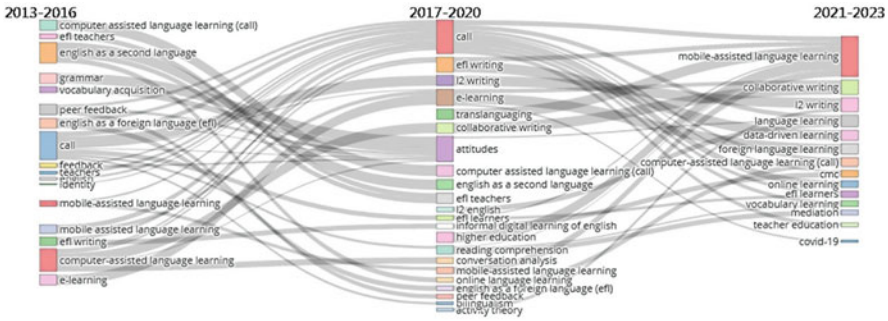

Fig. 40 Thematic evolution of keywords

The importance of identifying changes in terminology and the evolution of research fields in disciplines such as bibliometrics and scientometrics cannot be overstated. Thematic evolution analysis is a method used to reveal hidden key elements of the study, such as topics, by looking at the theme of the study about a specific topic but from different periods. Figure 47 depicts the evolution of keywords over three distinct periods (2013–2016, 2017–2020, and 2021–2023). It is important to note that the keywords "computer assisted language learning", "call", and "mobile assisted language learning" are important keywords as they are present in all three stages; however, covid-19 is only presented in the third stage. Most of the studies focused on using various technologies to improve language learning (Fig. 40).

3.6.1 Factorial Analysis

After conducting a factorial analysis of the author's keywords of the articles about the English language and technology, it was determined that the following concepts have a high factor load in the first dimension when examined in this study: computer-

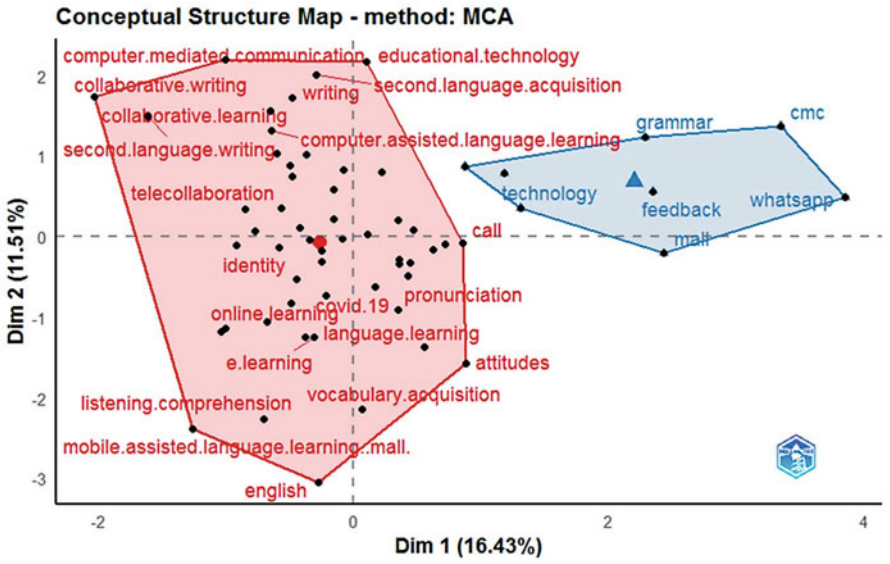

Fig. 41 Conceptual map and keyword clusters

mediated communication, collaborative writing, writing, second language acquisition, collaborative learning, second language writing, computer assisted language learning, telecollaboration, identity, call, online learning, pronunciation, language learning, e-learning, listening comprehension, attitudes, vocabulary acquisition, mobile assisted language learning, and English. Likewise, in the second cluster of keywords, you can find the following terms: technology, grammar, feedback, WhatsApp, mall, and CMC, among others (Fig. 41).

Dendrograms are diagrams that depict hierarchical relationships between objects, illustrated by their hierarchical arrangement. By contrast, hierarchical clustering illustrates the arrangement of the clusters determined by the corresponding analyses through a diagrammatic representation. As the name suggests, a dendrogram is primarily used to determine the best way to allocate objects to clusters based on their characteristics. Furthermore, the distance between the clusters can be seen on the Y-axis of the graph, which is the distance between the clusters, and on the X-axis, there are the subject concepts for which the data points of the clusters are grouped (Fig. 42).

3.7 Intellectual Structure

An intellectual structure is a methodological technique for identifying what authors, documents, or sources have had a major impact on the academic field (Kessler 1963; Small 1973). Several basic concepts describe a field, such as the major themes,

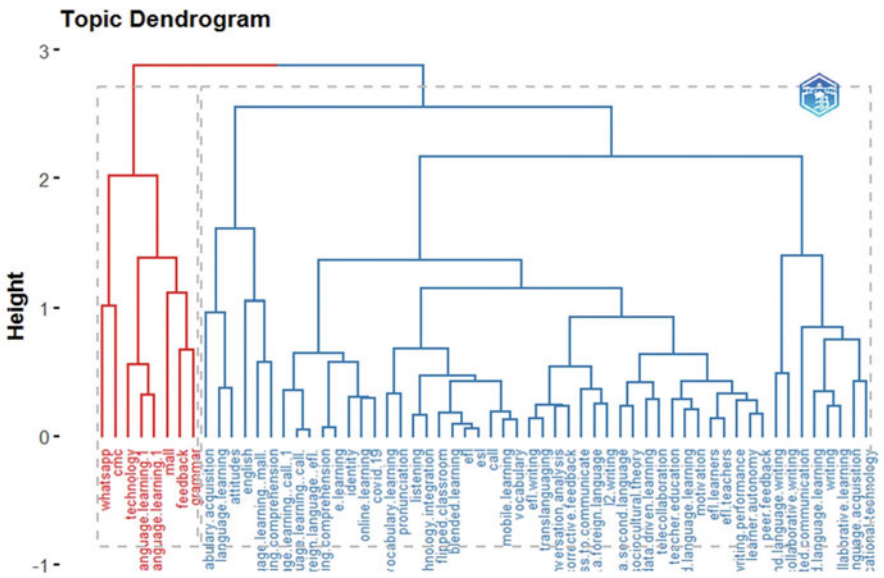

Fig. 42 Topic dendrogram

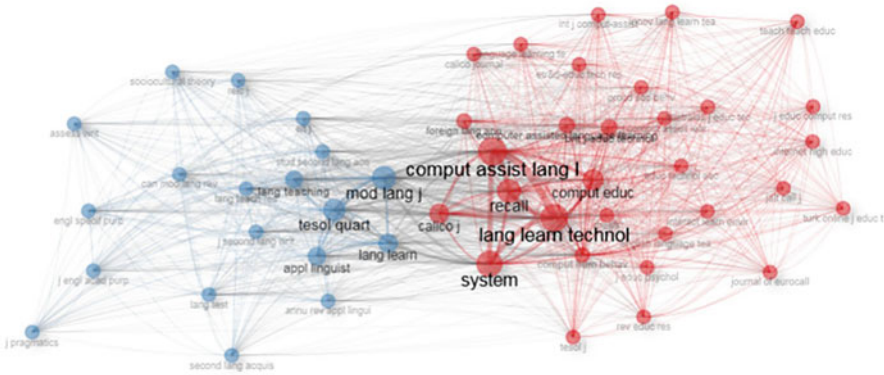

Fig. 43 Co-citation network of sources

subthemes, and patterns that are associated with that field. Co-citation network data shows that the result is a result of the impact of different sources on each other, which is clear from this graph (Fig. 43).

In addition, the degree plot diagram shows the cumulative degree of the sources based on the order in which they appear. Using the co-citation network, it is possible to see how the sources influence one another and how they are interconnected. The degree plot diagram represents the sources' cumulative degree in order of occurrence (Fig. 44).

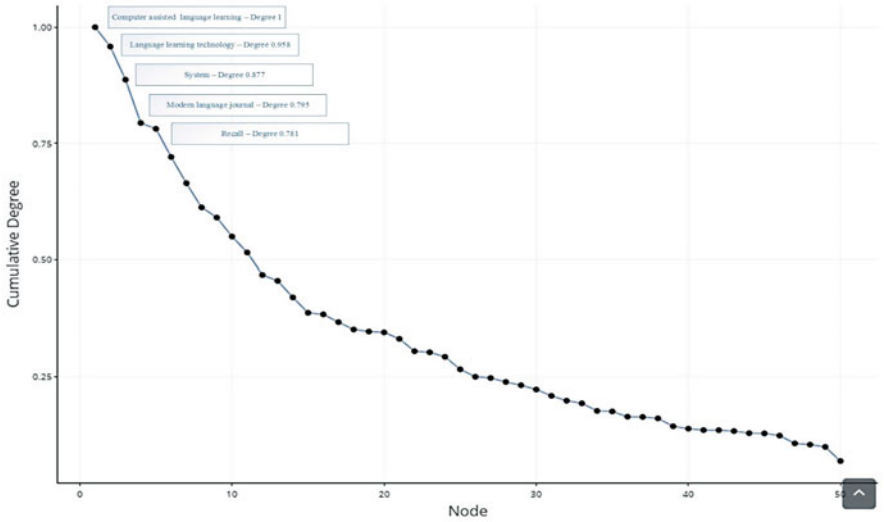

Fig. 44 Degree-plot of co-citation network of sources

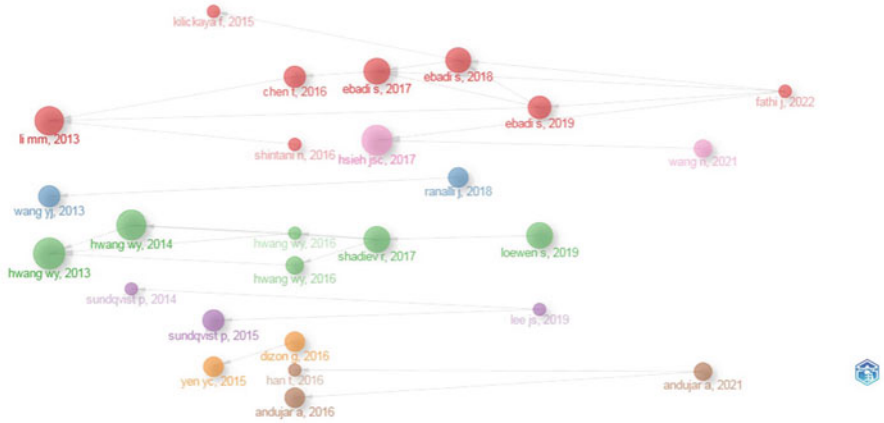

Fig. 45 Historigraph of first authors

Hence, as shown in Fig. 45, the historigraph of the study gives a full view of the document, keyword, and first author's collaboration, along with the year in which it was completed.

3.8 Social Network

Collaboration networks can be used to describe the social structure at the various levels of scientific cooperation (Glänzel 2002). In the last section, we are able to see

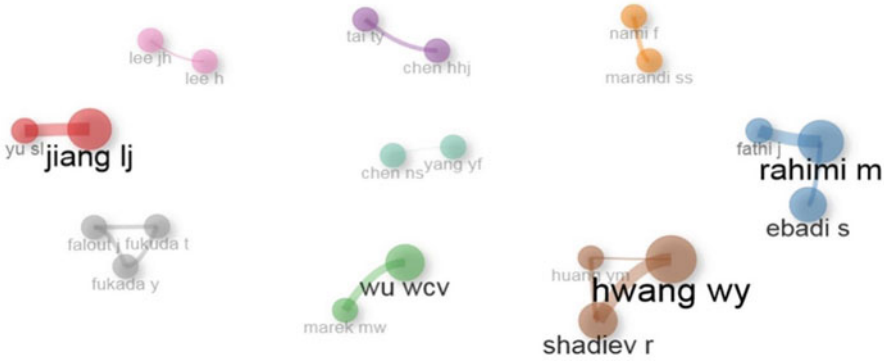

Fig. 46 Collaboration network of authors

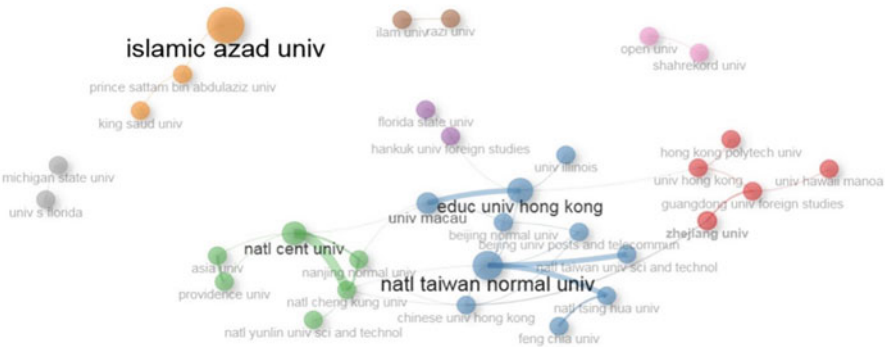

Fig. 47 Collaboration network of institutions

how authors, institutions, and countries collaborate, which illustrates an easier understanding of the issue. China was regarded as the number one country, followed by the USA and Iran. It is worth noting that Islamic Azad University in Iran was considered a leading institution in the world, followed by the National Normal University of Taiwan and Education University of Hong Kong. Among the authors with the most collaborations, HWANG WY, RAHIMI M, JIANG LJ, and WU WCV had the highest collaboration rates, respectively (Figs. 46, 47, and 48).

Additionally, this multi-purpose software allows users to visualize the collaboration between countries on the map. The frequency of the number of publications counted determines the thickness of each curve on the map of international collaborations. Thus, there is a very dense network between the USA and China. In other words, the USA has become CHINA's first international co-authorship partner with 30 frequencies. The United Kingdom became China's second international partner with 8 frequencies (Fig. 49).

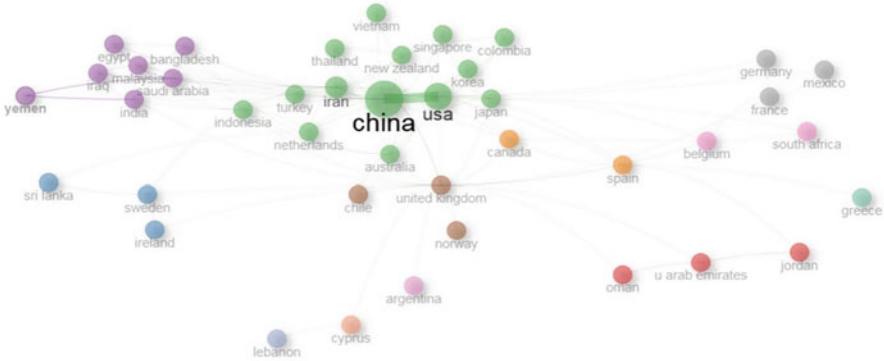

Fig. 48 Collaboration network of countries

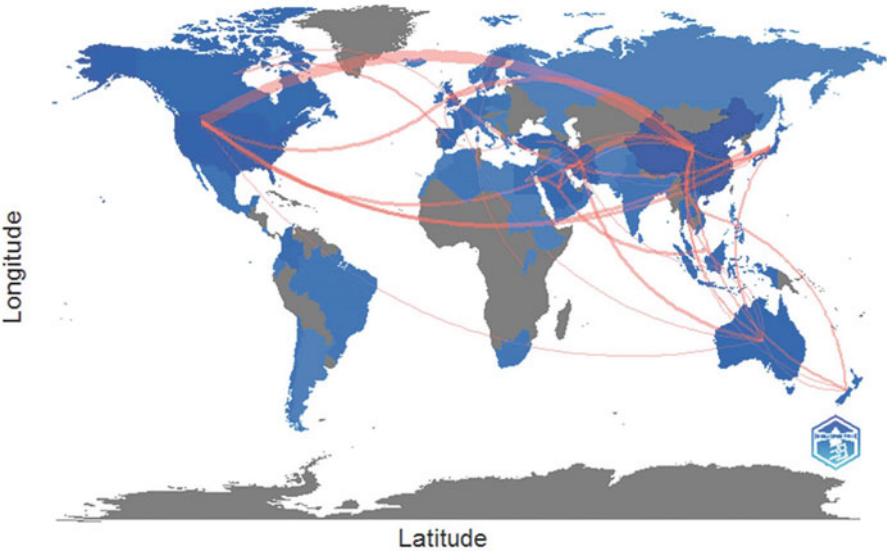

Fig. 49 Countries' collaboration across the world

4 Conclusion

It is very necessary and intriguing for academic professionals to be aware of the most popular research topics, such as books, journals, and other works that have made significant contributions to their field. Hence, scholars are encouraged to stay updated with research trends in their profession to make more educated judgments about the topics they will investigate and remain on top of emerging trends (Lei and Liu 2019). Furthermore, the significance of science mapping as a vital activity is becoming increasingly obvious to researchers working in every field of the scientific

discipline. There is no doubt that the number of publications is expanding at an accelerating rate and that many of these articles are emerging in a vague manner, which complicates the process of knowledge accumulation (Aria and Cuccurullo 2017). Meanwhile, policy and practice rely upon that, and it helps determine the intellectual framework and research frontiers of scientific subjects. Generally, it is common to use specialized software tools to perform only certain steps in a science mapping analysis. In fact, only a few of them are available to scholars that permit them to follow the complete workflow from start to finish. A comprehensive science mapping analysis of scientific literature can be implemented using the open-source software Bibliometrix. It is possible to gain information about a particular work's intellectual structure and conceptual framework due to bibliometric analysis, a data-driven approach to analyzing the literature. In this way, the user can gain insight into the progress of research on certain topics (Zupic and Čater 2015, 9).

Science mapping is becoming an essential activity for scholars of all scientific disciplines. However, in bibliometrics, the use of scientific workflows is still in its early stages. Moreover, it has become increasingly difficult to accumulate knowledge as the number of publications continues to grow exponentially (Aria and Cuccurullo 2017; Guler et al. 2016). Software tools that are specialized in science mapping analysis are commonly used only to perform certain steps of the process. In fact, only a few of these software allow scholars to follow the entire workflow in detail. This article has demonstrated how scientific workflow managers such as Biblioshiny, a powerful tool for managing bibliometric analyses that allows users to integrate online databases, statistical analysis, and data visualization, can facilitate scientific workflow management. Based on the above, identifying the intellectual structure and research frontiers of scientific domains has become vital to research, policy-making, and practice as a whole.

In summary, this study was conducted in order to introduce a bibliometric analysis using the Bibliometrix package and to introduce the Biblioshiny interface, which is easily implemented by the R programming language, and to perform a bibliometric analysis using the Biblioshiny. This study focused on English language and technology-related publications published in the fields of Language and Linguistics, Education and Educational Research. It is worth mentioning that between 2013 and 2022, 881 articles were searched in the WoS database.

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Concluding Remarks: Recommendations and Future Directions

Rajab Esfandiari and Hussein Meihami

1 Conclusions

The book chapters in this volume provide useful information and represent the state of the art in adopting scientometrics as a research perspective to explore uncharted territories in applied linguistics. The contributors have invested in several most frequently used computer programs, including CiteSpace, VOSViewer, Bibliometrix, and HistCite, to analyze the bibliometric data. Data visualization is used in almost all the chapters to depict the data in pictorial forms. Co-word analysis, co-citation analysis, and bibliographic coupling are employed as analysis techniques to identify clusters, patterns, and themes in cited records and to establish relationships between the documents. Large indexing databases (Web of Science and Scopus) have been used to locate the records for inclusion and analysis. The data types mainly include articles, and sample sizes range from 50 to 23,790 papers. The contributors have followed all these scientometric data methods, analysis procedures, and index measures to explore the "evolution of applied linguistics" (Dong and Dong, Chapter "Exploring the Evolution of Applied Linguistics: A Bibliometric Survey of Major Research Paradigms" this volume) to achieve the following goals: (1) Identifying research publications and topic trends; (2) locating the most highly cited authors, documents, affiliations, and countries; (3) detecting research foci, methodological orientations, and theoretical paradigms; and (4) mapping the structure and dynamics of the field, among others. In what follows, we sketch out future directions for further research.

Mapping the structure of the field is one major area in which applied linguistics appears to benefit from scientometrics. As Sooryamoorthy (2021) noted, the purpose

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of scientometrics as applied to social sciences and humanities is to "advance knowledge of the communication structures in research" (p. 58). The scientometric analysis of authors, documents, institutes, and countries, therefore, reveals many interesting points about the structure and dynamics of the field. Through a co-occurrence network, thematic clustering of keywords and titles of various documents, and cited authors, it is possible to delineate the conceptual structure of applied linguistics and deduce the close cognitive relationship of themes to better understand the various ways these elements interact with each other. In addition to conceptual structure, intellectual and social structures of the field are also worthy of exploration through the impact the authors, documents, and sources may have on the field as well as the various levels of scientific cooperation and collaboration authors they may have at national, or international, areas. The analysis of such complex structures through scientometric methods, such as co-citation analysis, contributes to the autonomy of the field, thereby distinguishing applied linguistics from neighboring fields such as linguistics. Mapping, therefore, may carry several implications for the field, including but not limited to what applied linguistics looks like, who the main agents and actors are, what the major developments and breakthroughs are during a particular period, who has had the greatest impact in the field, and who is responsible for a change. In other words, through mapping, the new movers, shakers, and innovators (Liu and Hu, Chapter "Research Trends in Applied Linguistics (2017–2021): A Scientometric Review of 42 Journals" this volume) who may have conceptually, methodologically, and theoretically revolutionized the field are identified.

The scientometric analysis also helps applied linguists to identify the publication trends across universities, institutes, and countries over time. The steady growth (or lack thereof) of research orientations (quantitative, qualitative, and mixed-methods) in research articles, the number of times they tend to be cited in research journals, and the venues the research outputs are published help readers in the field to make informed decisions about which research paradigm dominates the field, which research journals to prioritize for the submission of new manuscripts, and which countries to search for getting scholarships.

Applied linguistics was heavily influenced by structural linguistics and behavioristic psychology, which promoted the scientific method in resolving real-life problems and followed quantitative methods to research real-world phenomena. By implication, applied linguistics followed the tenets of these two schools of thought and tended to be quantitatively oriented in paradigm, favoring measurable methods for addressing language problems, issues, and phenomena. Such an orientation still tends to dominate applied linguistic research, as the majority of research outputs are quantitative, with positivism as the dominant research paradigm (Dong and Dong, Chapter "Exploring the Evolution of Applied Linguistics: A Bibliometric Survey of Major Research Paradigms" this volume). Scientometrics, as the chapters in this volume show, contributes to this tradition and expands the boundaries of quantitative research through systematically synthesizing research findings by focusing on the publication metadata such as citation counts, research trends, cited authors and references, article titles and author-assigned keywords, among others.

Evidently, applied linguistics is reaping the rewards of scientometrics to offer possible solutions in the field, and it has conceptually, methodologically, and theoretically proved promising. Conceptually, scientometrics appears to be a very useful concept. Although it is very new to the field of applied linguistics, scientometrics has generated a number of major published research outputs in academic research journals, and this trend is most likely to continue in the future. Methodologically, as Chong and Plonsky (2023) commented, bibliometric reviews, as research synthetic tools, "appear to be surging" and are capable of usefully and reliably aggregating or summarizing research in a given domain, facilitating research dialogues between sub-fields and decreasing redundancies in the published literature, as evident in the overwhelming majority of chapters in this volume. Theoretically, applied linguistics can use scientometric procedures to determine the underlying reasons behind, for example, why a nucleus of periodicals receives the largest number of research papers, as shown in Daneshvar Ghorbani (Chapter "Bibliometrix: Science Mapping Analysis with R Biblioshiny Based on Web of Science in Applied Linguistics" this volume).

2 Recommendations and Suggestions for Further Research

One major strand of research contributing substantially to strengthening scientometric methodology in applied linguistics relates to quality-control metrics in evaluating bibliometric studies—what Amini Farsani and Jamali (Chapter "Top Topical Trends and Research Frontiers of Applied Linguistics Research Articles with Different Methodological Orientations: A Bibliometric-Synthetic Review" this volume) term meta-bibliometrics and it deals with the study of bibliometrics itself, including strand and orientation maturity, data extraction and collection, data analysis, reproducibility, motivators/incentives, and inferences (Amini Farasani, personal communication, 26 July 2023). To conduct high-quality secondary studies, including scientometric analysis, researchers need to adopt a conceptual and methodological map to inform them of developing a decent topic and executing a secondary, research synthetic study, and this requires a bibliometric-in-research policy, in the absence of which applied linguistics researchers may encounter serious problems in implementing scientometric reviews. Therefore, a strategically retrospective-prospective map is central to providing direction and establishing coherence to the field, and setting guidelines for conducting bibliometric research, establishing bibliometric agenda, and prioritizing bibliometric research are crucial for the more effective advancement of the field.

Scientometrics is, methodologically, a research synthetic method, albeit in a different way, which applied linguistics researchers are using to review, synthesize, and report the bibliometric features of the extant primary and secondary studies, which can be performed both diachronically and synchronically. Some researchers have combined scientometric techniques with other research methods, such as data mining tools (Dong and Dong, Chapter "Exploring the Evolution of Applied

Linguistics: A Bibliometric Survey of Major Research Paradigms" this volume), to analyze research paradigms and research synthesis techniques (Amini Farsani and Jamali, Chapter "Topical Trends and Research Frontiers of Applied Linguistics Research Articles with Different Methodological Orientations: A Bibliometric-Synthetic Review" this volume) to examine methodological orientations. Another research area, therefore, may be mixing scientometric methods with other research procedures to come up with more innovative research methodologies to do justice to the field and represent its complex nature.

A third fruitful area for further research concerns investment in distinct genres to give a full picture of the field. Almost all the studies applying scientometric procedures in applied linguistics tend to focus on research articles (either primary or secondary), as evidenced by the book chapters in this volume, the special issue specifically devoted to bibliometrics in applied linguistics to appear in Studies in Second Language Teaching and Learning (Plonsky 2023), and the papers published in research journals (e.g., Zakaria and Aryadoust 2023). Although research articles make up mainstream genres in academia and tend to be convenient forms of disseminating knowledge, they do not necessarily represent the field, and other forms, including book chapters, conference papers, and textbooks, among others, need to be considered to help us to grasp the broader perspective. As such, concurring with Sato and Loewen (2019), we also urge applied linguistics researchers "to widen the door" (p. 9) and synthesize research in as diverse genres as possible to explore the evolution of the field.

Fourth, when conducting scientometric reviews, applied linguists should attend to paradigmatic orientations. Amini Farsani and Jamali (2023), for example, cast light on this issue and reveal that methodological orientations such as quantitative, qualitative, mixed-methods research, and systematic reviews need unique and specific bibliometric studies such as collaboration, topic trends, and citations, among others. As such, conducting specific bibliometric studies for each paradigm is a fresh line of research for future studies. Considering the growing use of MMR in applied linguistics in the second decade of the twenty-first century, as observed by Riazi and Amini Farsani (2023), and given the centrality of innovative mixed-methods research (Riazi 2016), it seems that the time is ripe for bibliometrising MMR-based studies in terms of citations, topical issues, collaboration, research frontiers, etc.

A fifth line of inquiry concerns the match (or lack thereof) between disciplinary contexts and discipline-specific journals. Habibie and Fazel (Chapter "An Analysis of Writing for Publication Research on Novice Anglophone (L1) Academics: A Scientometric Perspective" this volume) show that scholars do not always, or often, publish within journals in their disciplinary realms. This requires further research to shed light on the underlying motivations for why researchers tend to opt for publication venues other than their research-specific journals. Although intuitively, this might be because of visibility purposes, the journals' considerable variations in impact factor, and journals' indexing databases, this merits additional empirical evidence.

It is also important to follow an interdisciplinary approach where both applied linguistics, and bibliometrics can work together on challenging topics in the field. One such research area is the use of bibliometrics to highlight the role of various theoretical underpinnings and philosophical and epistemological foundations in addressing the complex and multilayered L2 problems. It is essential to understand which cognitive and/or sociocultural theories are used by AL researchers in different research frontiers or topic orientations and whether the studies are mono-theoretical or metatheoretical (an amalgamation of cognitive and sociocultural perspectives). Quality should also be taken into consideration when conducting research, especially with the increasing emphasis on evidence-based educational research. The credible inferences of bibliometrics can inform policy-oriented research to make informed decisions. A very interesting area of research is collaboration networks in the context of the neoliberal era in education research. This research examines how neoliberal ideologies impact authorship, collaboration, and topic selection and what kind of collaboration map can be expected from this perspective.

In addition to the research frontiers we outlined in the foregoing paragraphs, we believe the following areas deserve scientometric exploration and analysis. Applied linguistics researchers may use more creative ways to research these topics to add to our knowledge and to expand the field's frontiers to enrich its multidisciplinary nature.

- Gender disparity in applied linguistics research publications,
- Authorship patterns and international collaboration in applied linguistics research (e.g., the order of authors, significance of the order for the dominance of the authors, and networks of collaboration across applied linguistics sub-disciplines),
- Citations and self-citations in applied linguistics research (e. g., citation behavior and practices between novice and expert applied linguists; citations in open, closed, and hybrid access applied linguistics journals; the relationship between applied linguistics research articles' length and structure and the citation outcomes; the relationship between subject areas; and the relationship between the number of authors and the number of citations),
- Research assessment and evaluation of research activities across authors, institutions, and countries in applied linguistics research,
- Knowledge production in applied linguistics research through the analysis of publication outlets and their origin (national and international) and
- Research journals' editorial policies concerning publication in applied linguistics.

In closing, scientometric research has just begun to develop in the field as a new, promising research methodology in tandem with other, long-established research methods such as systematic reviews and meta-analyses (Esfandiari and Saleh 2023; Meihami and Esfandiari 2021; Rashidi and Meihami 2018; Sahragard and Meihami 2016). It appears to have gained traction and tends to attract applied linguists' attention more than ever. This is evidenced by the higher number of research publications in applied linguistics research journals, including Applied Linguistics, System, Journal of English for Academic Purposes, English for Specific Purposes, and Journal of Second Language Writing. The special issue on "Bibliometrics in

applied linguistics" edited by Plonsky published in Studies in Second Language Teaching and Learning and the present volume also confirm the growing interest that scholars show in Scientometrics. We expect this trend to continue in the near future and hope this line of inquiry will receive the attention it deserves.

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