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Exploring Research by Diane Larsen-Freeman: A Scientometric Analysis

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Abstract

There is a strong need to understand Diane Larsen-Freeman's main research interests and to investigate the theories and thesis she put forth. Moreover, it seems necessary to examine her contribution to applied linguistics and understand the claims and criticisms she has made throughout her career. This study aims to present an analysis of her studies within the scope of research trends, themes, topics, documents, and sources. Within the scope of the retrospective scientometric approach, 56 research papers from the Web of Science (WOS) database were analyzed. The results showed that Larsen-Freeman published her studies in the time span between 1987 and 2022. The most productive years can be considered in two periods, namely the years between 2006 - 2012 and 2015 - 2020. It was also concluded that the most relevant sources were published in reputational journals in the field of Applied Linguistics. The last conclusion was that Larsen-Freeman who has a high value of *h* index is an influential scholar in the field of Applied Linguistics, mainly focused on chaos/complexity science, complexity, second language acquisition, complex adaptive system, fluency, accuracy, and language emergence.

Keywords: *Diane Larsen-Freeman, Research, Scientometric Analysis*

Introduction

Diane Larsen-Freeman, born in 1946, served as a Peace Corps volunteer teaching English in Sabah, Malaysia from 1967 to 1969. She attributes this experience to sparking her interest in language learning. Later, she pursued graduate work at the University of Michigan, where she graduated with a Ph.D. in the field of Linguistics in 1975. Prior to joining the School for International Training (SIT) Graduate Institute, Larsen-Freeman taught at the University of California, Los Angeles. She returned to the University of Michigan to lead the English Language Institute in January 2002 after holding positions at UCLA and the SIT Graduate Institute, where she currently serves as professor emerita. She currently holds the positions of professor of education and linguistics and research scientist at the English Language Institute

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of Michigan. At the School for International Training in Brattleboro, Vermont, she holds the title of Distinguished Senior Faculty Fellow. Professor Larsen-Freeman, who has also been working as a teacher educator for more than 30 years, has written numerous books and articles on the subject of second language acquisition research, English grammar, and language teaching techniques (Diane Larsen-Freeman, 2023). Diane Larsen-Freeman is also an international speaker who has given talks in 65 different countries. Furthermore, she is the author of nine books, one of which won the Modern Language Association's Kenneth W. Mildener Book Prize. For five years, she also served as the editor of *Language Learning*. In addition, she received the American Association of Applied Linguistics' highest accolade, the Distinguished Scholarship and Service Award. In 2017, a collection of essays honoring her scholarship was released (Larsen-Freeman, 2017).

By using the lens of complex dynamic systems theory, Larsen-Freeman concentrates her research and interests on comprehending the second language acquisition process. The theory offers fresh perspectives on how language is learned and used. She considers the dimensions to be intricate, non-linear, and dynamic processes. She additionally studies English grammar. She sees English grammar as a valuable tool for creating meaning, properly adjusting language to the communicative context, and being a collection of structural patterns. Her dynamic interpretation of language, "grammaring," she refers to the practice of teaching grammar. The method also recognizes students' unique routes to mastering a second language and sees teaching as primarily a process of assisting students in perceiving affordances in the teaching-learning environment. Larsen-Freeman is renowned for her work in teacher education and language teaching methodologies, particularly in the TESOL sector. At the end of 2012, Diane-Larsen Freeman announced her retirement. She has since served as a Visiting Senior Fellow in the Graduate School of Education at the University of Pennsylvania's Educational Linguistics Division.

Second language acquisition and foreign language learning is complicated and adaptive. Due to the inherent complexity of the mentioned processes, it is inevitable that target groups will encounter difficulties while attempting to teach, learn, and assess the language using native-like standards. From this perspective, Larsen-Freeman has spent more than 40 years attempting to explain second language acquisition and foreign language learning from static and linear vantage points within the scope of theoretical research. Her research on Chaos/Complexity Theory (Larsen-Freeman, 2009) offers fresh perspectives on how languages work and develop, which can be used to better understand languages as well as create teaching and learning methods and evaluations that are more equitable for language learners (Garcia-Ponce & Mora-Pablo, 2017). This is mostly because of her experience as a language teacher for many long years who had the opportunity to observe the hassles and think about the probable solutions. On the other hand, it is of utmost importance to follow, read and analyze the research by Larsen-Freeman for several reasons. First, there is a strong need to understand her main research interests and to investigate the theories and thesis she put forth. Second, it seems necessary to examine her contributions to applied linguistics and understand the claims and criticisms she has made throughout her career. With these goals in mind, this study aims to present an analysis of her studies within the scope of research trends, themes, topics, documents, and sources. From this perspective, the current study aims to

explore the papers authored by Diane Larsen-Freeman and seeks to answer one research question:

RQ: What are the featured trends, themes, topics, documents, and sources in the studies by Larsen-Freeman on FLE?

Method

Scientometric Investigation

Among several qualitative and quantitative methods used to comprehend and organize earlier research, scientometrics has been utilized for measuring the impact of scientific publications and the related level of knowledge dissemination using statistical techniques. The present paper utilizes the Bibliometrix software for science mapping analysis. Aria and Cuccurullo (2017) introduced a freely accessible R-based software called Bibliometrix, which enables the examination of bibliographic data through various science mapping methods, such as citation analysis and co-citation co-authorship analysis, and keyword co-occurrence analysis. This software is also enhanced with visualization tools and offers a range of statistical tools.

To find out the featured trends, themes, topics, documents, and sources in the studies by Larsen-Freeman on Applied Linguistics, the present study included a three-stage investigation; data extraction and pre-processing, analyses on the level of sources, documents, and authors' performance before visualization and layout processes (Börner, 2007). The first stage involved the acquisition of data from the WOS. In the second phase, document analysis was performed to group and analyze the articles (Glänzel & Schubert, 2003). In this stage, empirical measures were generated using Biblioshiny. Last, the results were presented in tables and figures. The stages and particular techniques employed in the present research are described in greater detail below.

Data Extraction and Pre-processing

The first step of the present investigation was the extraction and pre-processing (Börner, 2007) of the publications by Larsen-Freeman. The data were sourced from WOS, a global citation database and a research engine allowing for tracking 1.9 billion cited references from over 171 million records (*Web of Science*, 2022). The WOS database was preferred in this study due to its completeness and comprehensiveness, which makes it a reliable network for the discovery and assessment of publications. In addition, relying on a single database was deemed appropriate regarding both confidence and comprehensiveness, as Chen et al. (2017) noted. The first round of data searches was conducted on November 30, 2022. The search was conducted using the author's name as 'Larsenfreeman' and 'Larsen-Freeman'. The search yielded 56 results comprising 24 research articles, 12 book chapters, five proceedings papers, two book reviews, six editorial materials, one letter, and six review papers. All of the records were included in the analysis.

Analytical Procedures

Through analyses of the citation, co-citation and co-occurrence patterns and descriptive statistical information, science mapping is used to explore the hidden patterns in a given body of knowledge and dynamic evolution over time (Börner et al., 2003). Biblioshiny can be employed as a science mapping analysis tool at four different level metrics: sources, authors,

documents, and words. While sources refer to journals in which the articles were published, authors refer to the corresponding authors of each paper. Conversely, documents refer to all published work in the data set (Aria & Cuccurullo, 2017). In addition, Biblioshiny also enables analysis of the knowledge or intellectual structure of a field of study in three distinct structures of knowledge, known as K-structures. As described by Aria and Cuccurullo (2017), these include the conceptual, intellectual, and social structures to better comprehend the structure within a set of publications. Analyzing these structures involves examining patterns at multiple levels, including sources, authors, and documents, while scrutinizing statistical information and the co-occurrence of words that appear in titles, abstracts, and keywords. According to Börner et al. (2003), science mapping enables researchers to uncover hidden patterns within the conceptual, social, and intellectual structure of a field of knowledge and observation of how these patterns evolve over time through analyses of citation, co-citation, and co-occurrence patterns, along with descriptive statistics. Since the present research focuses on a single author, the analysis was confined to the investigation of conceptual structure within the publications authored by Larsen-Freeman throughout her career.

The presentation and discussion of results start with an overview of the statistical information on the author's publications before giving descriptive statistics focusing on the author's productivity over time. Then, the sources in which the author's works were published were analyzed to discover the most relevant sources, most locally cited sources which refer to the citation information within the data set; source local impact based on *h* index, source clustering through Bradford's Law, which is known as the law of diminishing returns and scattering (Nash-Stewart et al., 2012); and source dynamics. In the document analysis, the works published by the author were analyzed in terms of the most cited papers and references. While the most cited papers demonstrate the times papers published by the author were cited, the most cited references focus on works that the author cited. Next, a word analysis was performed to see the most frequent word occurrences in the studies by Larsen-Freeman in single-word forms as well as two and three-word clusters. The co-occurrence patterns of keywords, the thematic map, and the evolution of themes were analyzed to investigate the conceptual structure and its evaluation over time. Lastly, factorial analysis, which is a data reduction technique, was conducted to identify subfields and focal topics within the author's publications. Further definitions and methodological explanations are given under relevant subtitles for a more reader-friendly presentation and discussion of findings.

Results

Larsen-Freeman published 56 papers in 33 sources indexed in the WOS within the time span between 1987 and 2022. The annual growth rate was 1.17% in the document average age. The average citations per paper were found to be 12.8 with a total reference of 2,361. In addition, the average citation per document was calculated as 60.7. In the papers, the numbers of keywords were 104 regarding Keywords Plus and 78 regarding the authors' keywords. Forty-one authors produced the papers, while Larsen-Freeman was the single author of 40 documents. The number of co-authors per document was 1.8, whereas the % of international co-authorship was found to be 12.5. Regarding document types, Larsen-Freeman produced 24

research articles, 12 book chapters, five proceedings papers, two book reviews, six editorial materials, one letter, and six review papers.

Annual Scientific Production and Average Citations per Year

According to the values presented in Table 1, it can be noticed that Larsen-Freeman did not publish any works in certain spans, including the years between 1988 and 1990, 1992 and 1994, and 1999 and 2002 in addition to 2021. The highest mean values regarding total citations per paper were 479 in 1997 ($\bar{x}=18.4$), 299 in 2006 ($\bar{x}=17.6$), 161.5 in 2009 ($\bar{x}=11.5$), and 159.3 in 2016 ($\bar{x}=22.8$), as shown in Table 1. The values point out that the author has remained a leading scholar through three decades from 1990 to 2021. While her work gained significant scholarly attention in 1991 and peaked in 1997, she also appeared to have made remarkable contributions in shaping the intellectual structure of the field towards 2020.

Table 1

Annual Scientific Production and Citations

Year	N	Mean for total citation per article	Mean for total citations per year	Citable years
1987	2	3.0	0.1	36
1991	2	22.5	0.7	32
1995	2	10.5	0.4	28
1997	1	479.0	18.4	26
1998	2	5.5	0.2	25
2003	1	1.0	0.1	20
2004	1	32.0	1.7	19
2006	2	299.0	17.6	17
2007	3	69.3	4.3	16
2008	3	66.3	4.4	15
2009	4	161.5	11.5	14
2010	1	19.0	1.5	13
2011	3	33.3	2.8	12
2012	3	29.0	2.6	11
2013	1	71.0	7.1	10
2014	1	11.0	1.2	9
2015	3	56.3	7.0	8
2016	3	159.3	22.8	7
2017	1	3.0	0.5	6
2018	5	17.6	3.5	5
2019	2	41.0	10.3	4
2020	5	5.4	1.8	3
2022	3	4.3	4.3	1

Sources

Table 1 shows that the most relevant sources that publish the studies by Larsen-Freeman can be classified into three zones. The first and dominant sources were *Modern Language Journal* (n=7), *Language Learning* (n=6), and *Language Teaching* (n=6). In the second zone, she published four papers in *Applied Linguistics* and four papers in *TESOL Quarterly*. The numbers of the studies in the last zone were two in *Studies in Second Language and*

Teaching, one in *Alternative Approaches to Second Language Acquisition*, one in *Annals of American Academy of Political and Social Science*, one in *Bilingualism – Language and Cognition*, and one in *Chinese Journal of Applied Linguistics*.

Table 2
Most Relevant Sources

Zone	Sources	Number of sources
1	Modern Language Journal	7
	Language Learning	6
	Language Teaching	6
2	Applied Linguistics	4
	TESOL Quarterly	4
3	Studies in Second Language and Teaching	2
	Alternative Approaches to Second Language Acquisition	1
	Annals of American Academy of Political and Social Science	1
	Bilingualism – Language and Cognition	1
	Chinese Journal of Applied Linguistics	1

The values in Table 3 indicate that the most locally cited sources are categorized into two zones. The first zone included *Modern Language Journal* (n=181), *Language Learning* (n=173), and *Applied Linguistics* (n=160). The numbers of citations in the second zone were 65 for *TESOL Quarterly*, 54 for *Language Teaching*, 49 for *Studies in Second Language Learning and Teaching*, 42 for *International Review of Applied Linguistics in Language Teaching*, 35 for *Complex Systems and Applied Linguistics* (book), 31 for *Second Language Acquisition*, and 28 for *Language Acquisition*.

Table 3
Most Locally Cited Sources

Zone	Sources	Cited sources
1	Modern Language Journal	181
	Language Learning	173
	Applied Linguistics	160
2	TESOL Quarterly	65
	Language Teaching	54
	Studies in Second Language and Teaching	49
	International Review of Applied Linguistics in Language Teaching	42
	Complex Systems and Applied Linguistics	35
	Second Language Acquisition	31
	Language Acquisition	28

When the source clustering through Bradford's Law is considered, it can be seen that the core source consists of three sources. *Modern Language Journal* was in the first rank, while *Language Learning* was in the second rank. Finally, *Language Teaching* was in the third and last rank.

Table 4 shows the impact of the sources that publish Larsen-Freeman's papers regarding the *h* index in four zones and source dynamics. First, the *h* index was 6 for *Modern Language Journal* and 5 for *Language Learning*. Second, the value indicating the *h* index was 4 for *Applied Linguistics* and 4 for *Language Teaching*. In the third zone, the *h* index was 3 for

TESOL Quarterly, while the mentioned value was 2 in *Studies in Second Language Learning and Teaching*. In the last zone, the value for the *h* index was 1 for the sources of *Alternative Approaches to Second Language Acquisition* (book), *Annals of the American Political and Social Science*, *Bilingualism-Language and Cognition*, and *Chinese Journal of Applied Linguistics*. As a final note, the same order can be observed in source dynamic indication in accordance with cumulative occurrences and years.

Table 4
Impact of the Sources

Zone	Sources	<i>h</i> index
1	Modern Language Journal	6
2	Language Learning	5
	Language Teaching	4
	Applied Linguistics	4
3	TESOL Quarterly	3
	Studies in Second Language and Teaching	2
4	Alternative Approaches to Second Language Acquisition	1
	Annals of American Academy of Political and Social Science	1
	Bilingualism – Language and Cognition	1
	Chinese Journal of Applied Linguistics	1

The Author

The values in Table 5 show the local impact of the studies by Larsen-Freeman. The author had a value of 22 for the *h* index and 54 for the *g* index with 2,941 total citations. The value for articles fractionalized was found to be 46.3. The proportion of the author was 0.88 in the range between 0 and 1 when the co-authorship was considered. Larsen-Freeman mostly co-authored with Ellis who had a betweenness value of 290 and a closeness value of 0.02 with a 0.06 page rank.

Table 5
Local Impact

<i>h</i> index	<i>g</i> index	Total citations	Number of papers	Articles Fractionalized
22	54	2,941	56	46.3

Document Analysis

The most cited articles are listed in Table 6, including the findings regarding total citations, total citations per year, and normalized global citations. The most influential study regarding total citations focused on chaos/complexity science and second language acquisition (Larsen-Freeman, 1997) and had 479 citations. The following study, designed to be a position paper on the complex adaptive system, had 457 citations (Beckner et al., 2009). Another influential study that had 416 citations drew a transdisciplinary framework for SLA in a multilingual world (Atkinson et al., 2016). Next, a paper that examined the emergence of complexity, fluency, and accuracy in the oral and written production of five Chinese learners of English was cited 329 times (Larsen-Freeman, 2006). The mentioned study had 269 citations and focused on language emergence within the scope of Applied Linguistics (Ellis & Larsen-Freeman, 2006). Then, the paper on research methodology on language development from a

complex systems perspective was cited 156 times (Larsen-Freeman & Cameron, 2008). The mentioned study had 106 citations and included reflective commentary on the cognitive-social debate in second language acquisition (Larsen-Freeman, 2007). The last paper that had more than 100 citations was a study on complexity, accuracy, and fluency in second language acquisition (Larsen-Freeman, 2009). Some other studies that had fewer than 100 total citations were a book chapter on the complexity theory approach to second language development/acquisition (Larsen-Freeman, 2011), a paper that included the analyses and computational simulations of the emergence of linguistic constructions from usage (Ellis & Larsen-Freeman, 2009), a paper on language learner agency from the complex dynamic systems theory perspective (Larsen-Freeman, 2019), a study on complex, dynamic systems within the scope of applied linguistics as a transdisciplinary theme (Larsen-Freeman, 2012), an article that discussed future directions in, and future research into second language acquisition (Larsen-Freeman, 2018), and an evaluation on the transfer of learning (Larsen-Freeman, 2013). The other studies had total citations fewer than 70 and focused on complex systems within the scope of applied linguistics (Cameron & Larsen-Freeman, 2007), grammar learning and teaching (Larsen-Freeman, 2015a), classroom-oriented research from a complex systems perspective (Larsen-Freeman, 2016), the complex dynamic systems theory (Larsen-Freeman, 2014b), language acquisition and language development (Larsen-Freeman, 2015b), and second language acquisition research (Larsen-Freeman, 1991).

Table 6
Most Cited Papers

Papers	Total citations	Total citation per year	Normalized global citations
Larsen-Freeman (1997)	479	17.74	1.0
Beckner et al. (2009)	457	30.47	2.83
Atkinson et al. (2016)	416	52.00	2.61
Larsen-Freeman (2006)	329	18.28	1.10
Ellis & Larsen-Freeman (2006)	269	14.94	0.90
Larsen-Freeman & Cameron (2008)	156	9.75	2.35
Larsen-Freeman (2007)	106	6.24	1.53
Larsen-Freeman (2009)	104	6.93	0.64
Larsen-Freeman (2011)	91	7.00	2.73
Ellis & Larsen-Freeman (2009)	84	5.60	0.52
Larsen-Freeman (2019)	81	16.20	1.98
Larsen-Freeman (2012)	77	6.42	2.66
Larsen-Freeman (2018)	74	12.33	4.20
Larsen-Freeman (2013)	71	6.45	1.00
Cameron & Larsen-Freeman (2007)	69	4.06	1.00
Larsen-Freeman (2015a)	62	6.89	1.10
Larsen-Freeman (2016)	61	7.63	0.38
Larsen-Freeman (2014b)	60	6.67	1.07
Larsen-Freeman (2015b)	47	5.22	0.83
Larsen-Freeman (1991)	42	1.27	1.87

Table 7 shows the most cited references used by Larsen-Freeman in her studies. The most cited reference was authored by Cameron and Larsen-Freeman (2007) who focused on complex systems and applied linguistics (n=35), while another paper that reported on chaos/complexity science and second language acquisition (Larsen-Freeman, 1997) was referenced 28 times. The third paper that was referenced 22 times by Larsen-Freeman was a research paper on the emergence of complexity, fluency, and accuracy in the oral and written production of five Chinese learners of English (Larsen-Freeman, 2006). The other papers that were referenced were the study by Ellis and Larsen-Freeman (2006) who focused on language emergence (n=18), the book on grammar teaching (n=18) by Larsen-Freeman (2003), and the paper that focused on interlanguage (n=18) by Selinker (1972). Larsen-Freeman also referenced the study by Corder (1967) who focused on the significance of learner's errors (n=16), the book by Kramersch (2003) who focused on language acquisition and language socialization in ecological perspective (n=14), the article by Larsen-Freeman (1991) on second language acquisition research (n=14), a book chapter by Larsen-Freeman (2017) on the Complexity Theory (n=13), a paper on the Dynamic Systems Theory approach to second language acquisition (n=12) by De Bot et al. (2007), and a book on the dynamic systems approach to the development of cognition and action (n=12) by Thelen and Smith (1994). The papers that were referenced 10 times by Larsen-Freeman were a book entitled *Chaos-making a new science* (Gleick & Berry, 1987), a book chapter on fossilization in second language acquisition (Larsen-Freeman, 2005), a book review (Larsen-Freeman, 2014a), and a paper on the morpheme acquisition order among second language learners (Larsen-Freeman, 1976).

Table 7
Most Cited References

Cited References	Citations
Cameron & Larsen-Freeman (2007)	35
Larsen-Freeman (1997)	28
Larsen-Freeman (2006)	22
Ellis & Larsen-Freeman (2006)	18
Larsen-Freeman (2003)	18
Selinker (1972)	18
Corder (1967)	16
Kramersch (2003)	14
Larsen-Freeman (1991)	14
Larsen-Freeman (2017)	13
De Bot et al. (2007)	12
Thelen & Smith (1994)	12
Gleick & Berry (1987)	10
Larsen-Freeman (2005)	10
Larsen-Freeman (2014a)	10
Larsen-Freeman (1976)	10

Word Analysis

Table 8 shows the list of the most frequent word occurrences in the studies by Larsen-Freeman in unigrams, bigrams, and trigrams. First, the occurrences in unigrams included the

words, *language* (n=70), *learners* (n=25), *complexity* (n=20), *development* (n=18), *acquisition* (n=13), and *learning* (n=17). The occurrences in bigrams were *complexity theory* (n=10), *applied linguistics* (n=8), *complex systems* (n=8), *language acquisition* (n=8), *dynamic systems* (n=7), and *language development* (n=7). Last, the trigrams were *complex dynamic systems* (n=7), *dynamic systems theory* (n=5), *applied linguistics research* (n=4), *complex non-linear systems* (n=3), *complex systems perspective* (n=3), and *second language acquisition* (n=3).

Table 8
Most Frequent Words

Unigrams	Occurrences	Bigrams	Occurrences	Trigrams	Occurrences
language	70	complexity theory	10	complex dynamic systems	7
learners	25	applied linguistics	8	dynamic systems theory	5
complexity	20	complex systems	8	applied linguistics research	4
development	18	language acquisition	8	complex non-linear systems	3
acquisition	13	dynamic systems	7	complex systems perspective	3
learning	17	language development	7	second language acquisition	3

Conceptual Structure

Based on the main themes and trends in a set of publications, a conceptual structure that refers to what is talked about (Aria & Cuccurullo, 2017), there are three clusters regarding the co-occurrence network, as indicated in Table 8. The nodes in the first cluster were listed as *emergence* (114.4) and *acquisition* (74.9). The betweenness values were 20.0 for *second language acquisition*, 0.0 for *interlanguage*, and 54.0 for *variability* in the second cluster. The nodes in the third cluster were *dynamic systems* (84.0) and *complexity* (0.0).

Table 9
Co-occurrence Network

Node	Cluster	Betweenness	Closeness	Page rank
emergence	1	114.4	0.03	0.16
acquisition		74.9	0.02	0.12
second language acquisition	2	20.0	0.01	0.05
interlanguage		0.0	0.01	0.04
variability		54.0	0.02	0.05
dynamic systems	3	84.0	0.02	0.07
complexity		0.0	0.02	0.02

The thematic map of the studies by Larsen-Freeman shows three clusters labeled as *second language acquisition*, *emergence*, and *complexity*, as seen in Table 10. The first cluster labeled as *second language acquisition* had centrality values with occurrences with *English* (435.1), *interlanguage* (122.2), *variability* (158.4), and *motivation* (110.4). The second cluster labeled as *emergence* had 11 occurrences with *acquisition* (555.4), nine

occurrences with *dynamic systems* (716.7), three occurrences with *discourse* (134.5), and two occurrences with the *sociocognitive approach* (2.8). The last cluster labeled *ad fluency* (185.1) and *accuracy* (30.2)

Table 10
Thematic Map

Occurrences	Words	Cluster	Cluster label	Centrality
5	English	1	second language	435.1
4	interlanguage		acquisition	122.2
4	variability			158.4
2	motivation			110.4
11	acquisition	2	emergence	555.4
9	dynamic systems			716.7
3	discourse			134.5
2	sociocognitive approach			2.8
3	fluency	3	complexity	185.1
2	accuracy			30.2

Table 11 shows the thematic evaluation of the studies by Larsen-Freeman within the scope of Callon's centrality and density. Callon's centrality indicates the importance of a theme across a full set of publications, while Callon's density is an indicator of the theme's development (Chen et al., 2019). In a chronological framework, the studies by Larsen-Freeman involved two periods. In the period between 1987 and 2012, the cluster labels were *interlanguage* (71.9), *emergence* (92.0), and *second language acquisition* (50.0). The second period between 2013 and 2022 included two clusters labeled as *dynamic systems* (74.4) and *second language acquisition* (50.0).

Table 11
Thematic Evaluation

Time span	Cluster	Callon centrality	Callon density
1987 - 2012	interlanguage	0.4	71.9
	emergence	0.8	92.0
	second language acquisition	0.0	50.0
2013 - 2022	dynamic systems	1.8	74.4
	second language acquisition	0.5	50.0

Factorial Analysis

Factorial analysis is a data reduction technique that is used to identify any subfields and focal topics within a set of publications (Aria & Cuccurullo, 2017). Within this scope, Table 12 indicates the factorial analysis of the words used in the studies by Larsen-Freeman in two dimensions. According to the values, the first dimension consisted of the words, second language acquisition (1.3), and interlanguage (0). Then, it involved the words that had a value of -0.1, variability, motivation, English as a second language, and instruction, while the words that had a value of -0.2 were dynamic systems, complexity, discourse, fluency, accuracy, children, competence, dynamic systems theory, grammar, lingua franca, multilingualism, social interaction, and World Englishes. Last, the statement, sociocognitive approach, had a value of -0.3, whereas automatization and morphology were the words that

had a value of -.04. The second dimension included the words, motivation (1.7), morphology (1.6), automatization (1.2), second language acquisition (0.5), interlanguage (0.5), variability (0.5), multilingualism (0.4), competence (0.4), dynamic systems theory (0.2), and fluency (0.2).

Table 12
Factorial Analysis

Words	Dimension 1	Dimension 2
second language acquisition	1.3	0.5
interlanguage	0	0.5
variability	-0.1	0.5
motivation	-0.1	1.7
English as a second language	-0.1	-0.1
instruction	-0.1	-0.3
dynamic systems	-0.2	-0.4
complexity	-0.2	-0.4
discourse	-0.2	-0.2
fluency	-0.2	0.2
accuracy	-0.2	-0.1
children	-0.2	-0.5
competence	-0.2	0.4
dynamic systems theory	-0.2	0.2
grammar	-0.2	-0.2
lingua franca	-0.2	-1
multilingualism	-0.2	0.4
social interaction	-0.2	-0.1
World Englishes	-0.2	-1
sociocognitive approach	-0.3	-0.1
automatization	-0.4	1.2
morphology	-0.4	1.6

Discussion

Specific points should be discussed in accordance with the conclusions reached in the study. First, when the periods of Larsen-Freeman's productivity are considered, her studies focus on various factors in relation to language acquisition and learning processes during her research career during 2006-2012 and 2015-2020. On the other hand, since the current study presents a quantitative analysis of her studies, a qualitative analysis of her research would be beneficial to gain a deeper and better understanding over the periods noted above. Moreover, Larsen-Freeman has a strong performance as an author and a co-author. However, it seems necessary to explore her performance as an author and co-author to assess those studies' impact. Second, Larsen-Freeman preferred journals that have a focused audience in the field of Applied Linguistics. Yet, her studies should also be examined from the perspective of dissemination of her studies in terms of broader interdisciplinary research and audience. As a note, while the values of *h* index to understand her impact on the field, how her studies impact language policy and practical aspects of language learning need further investigation.

Third, while the current study analyses Larsen-Freeman's research over time, it is also necessary to analyze and compare shifts in research interests in her research issues. For this, an interdisciplinary approach can be preferred for understanding the diverse perspectives of her research and exploring how this approach enriched her research in a qualitative manner. Fourth and last, as can be visualized from the document analysis, Larsen-Freeman focuses on the complexity of second language acquisition and development. From this perspective, it is evident that she has significantly contributed to the language acquisition and learning field. Within this scope, further investigation seems necessary for understanding how her research contributes to language teaching methodologies and the needs of language teachers and learners. For this, a thematic analysis that focuses on chronological shift would be helpful to understand how her studies changed language teaching methodology.

Some more points need to be clarified in accordance with the key terms and concepts. First, Larsen-Freeman focuses on *the complexity of second language acquisition*, emphasizes complexity that departs from traditional models of language acquisition and contributes to a system-oriented understanding of the acquisition process. Thus, her research should be evaluated regarding language learning methodologies. Second, her research that focuses on *interlanguage* significantly contributes to the understanding of the progress in terms of the relationships between native and second language acquisition. This contribution is significant for making implications for language teaching, specifically addressing the main characteristics of language learners who experience the various interlanguage stages. Third, Larsen-Freeman focuses on *motivation* that is affected by certain factors. In this way, her research is significant in enhancing second language acquisition and foreign language learning. Finally, Larsen-Freeman focuses on *fluency and accuracy*, the critical aspects of target language production. In this way, she contributes to language learning regarding communication, language context, and goals.

This study is not without limitations. First, the data were sourced from 56 papers indexed in the WOS. These papers are confined to research articles, book chapters, proceedings papers, reviews, materials, letters, and reviews. Second, the approach used in the study was the retrospective scientometric approach. Lastly, measuring and mapping the overall impact of Diane Larsen-Freeman is beyond the scope of this research, as she certainly made significant contributions to our understanding on various other grounds such as the talks she has given, the theses she supervised, consultations she provided, and many other ways, people, and works she has touched throughout her career. From this perspective, Larsen-Freeman is a prominent figure in the fields of Linguistics and language learning. Her groundbreaking theories have changed the perceptions of language acquisition, learning, and cognition among scholars and researchers.

Conclusion

According to the findings of this scientometric review that aims to explore the features of the studies by Diane Larsen-Freeman within the scope of 56 publications, several conclusions were drawn. Firstly, while Larsen-Freeman published her studies in the time span between 1987 and 2022, the most productive years can be considered in two periods, namely the years between 2006 and 2012 and 2015 and 2020. It should be noted that Larsen-Freeman mostly co-authors with Nick Ellis. Secondly, the most relevant sources she preferred to publish are

Modern Language Journal, *Language Learning*, and *Language Teaching*. In a similar way, the most locally cited sources are *Modern Language Journal*, *Language Learning*, and *Applied Linguistics*. The core sources in terms of local citations are *Modern Language Journal*, *Language Learning*, and *Language Teaching*. In addition, the journals that have the highest *h* index values are *Modern Language Journal*, *Language Learning*, *Applied Linguistics*, and *Language Teaching* according to the source dynamics. From this conclusion, it can be inferred that the journals that publish her studies are in the field of Applied Linguistics. The third conclusion is that Larsen-Freeman who has a high value of *h* index is an influential scholar in the field of Applied Linguistics. Within the scope, it can be noted that her most cited studies mainly focus on chaos/complexity science, complexity, second language acquisition, complex adaptive system, fluency, accuracy, and language emergence. In addition, the references she cited in her studies concentrate on the Complexity Theory, the Dynamic Systems Theory, acquisition, complex systems, cognition, fluency, accuracy, language emergence, teaching grammar, interlanguage, errors, language socialization, and fossilization.

Some conclusions can also be added regarding document analysis. First, Larsen-Freeman focuses on complexity of second language development and acquisition. Within this scope, she focuses on complexity theory and dynamic systems in the framework of Applied Linguistics. From a conceptual perspective, the issues she studies can be classified as language emergence, second language acquisition, and dynamic systems. Second, from a thematic perspective, second language acquisition studies involve English as a second language, interlanguage, variability, and motivation. In addition, emergence deals with acquisition, dynamic systems, discourse, and the sociocognitive approach, whereas the topic, complexity, is related to fluency and accuracy. Chronologically, Larsen-Freeman seems interested in interlanguage and emergence before 2012, while she concentrates on dynamic systems after 2013. Third and last, it is observed that the main factors in her studies are the acquisition process, interlanguage, variability, motivation, English as a second language, instruction, dynamic systems, complexity, discourse, fluency, accuracy, children, competence, grammar, social interaction, automatization, and morphology.

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