Structure of Research Topics of *Reading in a Foreign Language's* Publications in the Past Two Decades (2002-2020): A Bibliometric Analysis

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Abstract

This bibliometric study analyzed the research topic structure of the *Reading in a Foreign Language* (*RFL*) journal in the past two decades. Using two well recognized bibliometric approaches, namely, the keyword co-occurrence analysis and hierarchical cluster analysis, the study examined author keywords and their co-occurrence of 184 research articles from 2002 to 2020. Results revealed that (1) the journal covered a wide range of reading research topics, and its most frequently researched topics were extensive reading, reading fluency, vocabulary learning, reading of foreign languages other than English, etc; (2) frequently researched topics were clustered into eight groups, including development of reading fluency, learner factors, vocabulary, etc.; and (3) the network of research topics centered around six large nodes (i.e., standardized keywords), namely extensive reading, reading fluency, vocabulary learning, reader characteristics, reading instructions, and reading comprehension. The findings might help readers and potential contributors familiarize with the research topic structure of the *RFL* journal. This study has important pedagogical implications.

Keywords: keyword co-occurrence analysis, hierarchical cluster analysis, research themes, research topics, foreign language reading, second language reading

Reading in a Foreign Language (RFL) is a well-recognized and leading journal on second language reading. This online refereed journal (https://nflrc.hawaii.edu) is informative, supportive, and interactive. First, being informative, its 294 research articles published from 1983 (its founding year) to 2020 cover a wide range of topics. Second, it is supportive. From 2005, *RFL*'s feature column, Readings on L2 Readings, provides an annual bibliography of

studies on L2 reading at other venues, which includes journal articles, books and book chapters, reviews, and dissertations. To readers, its published 16 bibliographies are invaluable. Furthermore, *RFL*'s feature, New Directions in Reading Research, beginning from 2020, reports scholars' comments about emerging directions in reading research, which may inspire researchers and graduate students when they choose research topics. *RFL* is also interactive. Communications between editors and readers as well as contributors and readers are encouraged. In each issue, editors introduce the main content of articles and inform readers about coming special issues as well as changes of the journal management or new features. Some issues report readers' comments about research articles published in previous issues. In sum, *RFL* is an informative platform for readers and contributors who are involved in foreign language reading research.

However, given the rich source it provides, new readers or potential contributors may find it challenging to obtain an overview of *RFL* in a short time. They may find it demanding to quickly capture major research topics of articles that have been published so far. Furthermore, when research articles are read discreetly, readers can only obtain information about limited issues of reading research, or sometimes only partial information about one specific issue. If the research articles are studied holistically, a broader perspective about reading research might emerge, and new insights into reading research and instructions might be seen. With these considerations, the present bibliometric study intends to identify major research topics of the journal and how these topics are structured.

Different from many previous journal-based reviews, which relied heavily on researchers' personal experience or subjective judgments (e.g., Petticrew & Roberts, 2006; Jesson et al., 2011; Li & Wang, 2018), the present study employed a quantitative keyword co-occurrence analysis and hierarchical cluster analysis, which are two well recognized bibliometric approaches. Author keywords of a study reflect its core content, frequency of co-occurrence of the keywords indicates degrees of connections between these keywords, and the distance between them reveals to what degree they can be clustered (Chen et al. 2010; Chen, 2017; Dehdarirad et al., 2014). The keyword co-occurrence matrix is the basis of co-occurrence analysis and hierarchical cluster analysis. By analyzing keywords frequency and the co-occurrence matrix, a similarity matrix and a distance matrix can be obtained. The distance matrix is used for hierarchical clustering analysis. Based on the keyword co-occurrence matrix, a keyword connection network can be drawn. While the hierarchical cluster analysis reveals how two keywords can be clustered and further clustered based on distances between two keywords, the keyword connection network shows how important a certain keyword (i.e., a node) is in the network. These methods are related and complementary. These systematic and transparent review methods are expected to yield more objective results regarding major research topics, how they are structurally clustered, and how they are centered around certain topics.

Literature Review

Many cross-journal and journal-based reviews in the field of applied linguistics were conducted to gather information about research topics, research trends, or research methods in the field of applied linguistics. (e.g., Stapleton & Shao, 2018; Plonsky, 2014; Benson et al., 2009; Chaudron,

2001; Lei & Liu, 2019a, 2019b; Liu & Hu, 2021). One recent cross-journal review was conducted by Lei and Liu (2019b). They reviewed 42 journals in applied linguistics during 2005 to 2016 to identify the most frequently researched topics, the most highly cited publications, and shifts in research trends in applied linguistics. They found that most of the frequently researched topics remained constant while the number of publications in some topics (e.g., phonological, generative linguistic topics) decreased significantly, and some topics (e.g., sociocultural and identity issues) increased. Another cross-journal review was Liu and Hu (2021). Employing co-citation analysis (i.e., a pair of earlier texts cited together by a later text) of articles from two journals (i.e., *English for Specific Purposes and Journal of English for Academic Purposes*) they overviewed major research areas of English for specific purposes. They also identified main features of three evolutionary stages in the field, namely, the initial conceptualizing stage, the maturing stage, and the flourishing stage. Some cross-journal studies focused on research methodology. For example, Plonsky (2014) reviewed 606 quantitative studies published in two journals (i.e., *Language Learning and Studies in Second Language Acquisition*) and identified change patterns in design features, statistical analyses, and data reporting practices.

Some reviews are journal-based and mainly intend to attain an overview of research topics and trends of topic change. For instance, Stapleton and Shao (2018) reviewed 359 articles published in the first 20 volumes of *Language Teaching Research journal*. They first manually coded articles into categories and then counted the frequency of each category. They found that most frequently researched topics were instructional effects, teacher cognition, exploratory practice, and teacher education. Similarly, focusing on the journal of *System*, Lei and Liu (2019a) investigated the journal's research topics and their evolving patterns from 1973 to 2017. Research topics from abstracts and references were extracted, the frequency of each topic was counted, and Chi-square tests were used to investigate change patterns of topics. They found that most frequently researched topics were foreign language learning strategies and technology, and topics such as study abroad, identity, and self-efficacy increased significantly.

While these cross-journal and journal-based reviews could provide invaluable information for readers, the method that these studies used might bear some limitations. First, the coding of research topics in some previous studies was mainly dependent on researchers' personal experience and subjective judgments. However, coding a study into one category is not straightforward in some cases because some studies address more than one topic (Stapleton & Shao, 2018). Second, most previous studies treated research topics in a discrete manner. The research topics were generally arranged according to frequency counts, and each of them was regarded as an isolated topic, rendering it hard for readers to detect how topics were connected. However, research topics are a network, in which a certain topic may be closely connected with certain topics and loosely related to other topics. Moreover, one topic may connect with multiple topics while another one may be related to only a few. For example, speeded reading is likely to be closely linked to reading fluency but might be loosely related to vocabulary acquisition.

In response to this situation, the current study used keyword co-occurrence or co-word analysis and hierarchical cluster analysis to generate information about *RFL*'s major research topics and how they are structured. Co-occurrence techniques mainly include co-citation (pairs of earlier texts cited together by a later text), co-word (pairs of words in the texts of a corpus), and co-author analyses. The keyword co-occurrence analysis was used because, first, keywords of an

article provide information about its core content, which are more objective than categories assigned by researchers. In some cases, a certain study can hardly be classified under a single category. To deal with the challenge of categorization, some researchers put some articles into more than one category (e.g., Stapleton &Shao, 2018). Second, co-occurrences of keywords can better reflect the relationships between research topics, while mere occurrence frequencies of categories cannot provide such information. Furthermore, results of co-occurrence analysis can be visualized in dendrograms and connection networks by using other software, including R and Ucinet. This technique, first used in bibliometrics, now has been widely used in various social science disciplines (Cho, 2014; Song et al., 2016; Liu & Mei, 2016; Dehdarirad et al., 2014) except in applied linguistics. So far, only Liu and Hu (2021) used co-citation bibliometric analysis. In view of the benefits of keyword co-occurrence analysis, the current study attempted to examine research topics of *RFL* in the past two decades as well as how these topics were structured.

Three research questions are as follows.

1. What topics were explored most frequently in the journal of *Reading in a Foreign Language* in the past two decades as revealed by frequency of author keywords?
2. How were these topics clustered structurally as revealed by the hierarchical cluster analysis based on author keywords co-occurrence?
3. How were these topics connected as revealed by the author keywords connection network?

To explore answers to RQ1, information about frequency of author keywords was used. To find answers to RQ2, firstly a keyword co-occurrence matrix was constructed, based on which a similarity matrix and a distance matrix were built. Then, the distance revealed in the matrix was used for the hierarchical cluster analysis. Two keywords with a close distance can be clustered and further clustered with other keywords. However, this data-driven method may cluster two unrelated keywords. Thus, keywords connection network was complementarily used to examine how keywords are connected (i.e., RQ3). The keyword connection network shows how important an author keyword (node) is in the network. All author keywords are nodes in the network. More connections with other keywords lead to higher centrality (importance) of the author keywords.

The study

The keyword co-occurrence analysis of the present study involved six sequential steps, namely, (1) data collection; (2) standardization of author keywords; (3) construction of the keyword co-occurrence matrix; (4) hierarchical clustering; (5) visual presentation of keyword clusters; and (6) visual presentation of keywords connection network.

Data Collection

Research articles published in *RFL* during the past two decades (2002--2020) were first downloaded from its official website, https://nflrc.hawaii.edu. The initial year was set at 2002 because this is the year that journal articles provided keywords. A total of 184 research articles

were identified, excluding reviews, discussions, and features. These articles and their keywords were used for the present study.

Standardization of Keywords

Keywords of research articles, which were in the form of nouns, phrases, or abbreviations, were standardized manually in the present study. The standardization was guided by four principles (e.g., Dehdarirad et al., 2014). First, original keywords with different forms (e.g., plural and singular forms, uppercase and lowercase forms, complete spelled and abbreviated forms) but of the same meaning were standardized by using the most frequent keyword. For instance, "second language learning," "second language acquisition," and "language learning" were standardized into "L2 learning." "English as a foreign language," "ESL," "English as a second language," and "English as a foreign language in China" were indexed into "EFL." Second, keywords with similar meanings were merged. For example, "comprehension," "text comprehension," "second language reading comprehension," "adequate reading comprehension," "literal reading comprehension," "EFL reading comprehension," "reading comprehension performance," and "Chinese text comprehension" were changed into "reading comprehension." Expressions "intrinsic motivation," "extrinsic motivation," "motivational factors," and "L2 reading motivation" were indexed as "motivation." Third, ambiguous keywords were standardized by tracing back into the original article to determine their exact meanings. For example, the meaning of keyword "Japanese students" was not clear enough because it could be students learning Japanese or Japanese students learning a foreign language. After reading the article, the keyword was adjusted as "Japanese EFL students." Duplicate keywords with nearly the same meaning in one article were deleted. For example, some articles put both "reading speed" and "reading rate" as keywords. After standardization of keywords, "reading speed" was indexed as "reading rate". In this situation, we deleted one of them in order not to inflate its frequency.

Construction of the Keyword Co-occurrence Matrix

Frequencies of all standardized keywords were calculated by the Bibexcel software, which was developed by Persson et al. (2009). Keywords with high frequencies were then used to generate a co-occurrence matrix. The purpose of this step is to explore answers to the first research question, i.e., the most frequently researched topics in the past two decades.

Hierarchical Clustering

Based on the co-occurrence matrix, similarities between high frequency keywords were calculated with the index of Ochiai, and then a similarity co-occurrence matrix was created by using SPSS. The similarity co-occurrence matrix was then used to calculate distances between keywords, which were measured by the squared Euclidean distance (Dehdarirad et al., 2014), and a distance matrix was created. Based on the matrix, the hierarchical cluster analysis (HCA) was conducted with the Ward's method by using the R software (Ding et al., 2001). The HCA is often used to classify a set of items into clusters (groups) according to the similarities among the items (Galili, 2015).

Visual Presentation of Keyword Clusters

The clustering results of the keywords were then visualized in a dendrogram. The purpose of the hierarchical clustering and the visual presentation of keyword clusters was to find answers to the second research question which examines how frequently researched topics were clustered.
Visual Presentation of Keywords Connection Network
Finally, the network between keywords (in terms of centrality) was visualized based on the co-occurrence matrix by using Ucinet 6.0 and its embedded software NetDraw (Borgatti et al., 2002). The purpose of the last step was to find answers to the third research question, namely, how frequently researched topics are connected.

Results

Most Frequently Researched Topics during the Past Two Decades
Research topics were indicated by standardized keywords in the present study. From the 184 research articles,197 unique keywords with a total frequency of 1066 were obtained. After keyword standardization, a total of 126 unique keywords with a total frequency of 750 were acquired. Among these unique keywords, the highest frequency was 51 with 1 keyword (i.e., extensive reading), and the lowest frequency was 1 with 32 unique keywords. Table 1 shows top 20 high-frequency keywords. These 20 words accounted for 53.73% of the total 750 frequencies. Extensive reading was the most frequently researched topic in the past two decades with an occurrence of 51 times accounting for 6.8% of the total 750.

To more accurately capture research topics, information about the co-occurrence of keywords was collected. Extensive reading co-occurred with 42 other keywords. As shown in Table 2, it co-occurred most frequently with graded readers (12), followed by vocabulary learning (11), reading fluency (9), and motivation (9). Extensive reading co-occurred 6 times with 4 unique keywords (EFL, reading comprehension, reading instructions, and reading rate). It co-occurred 5 times with 3 unique keywords (occurrence rate, vocabulary knowledge, and reader characteristics), 4 times with 4 unique keywords (foreign languages other than English, statistical methods, affect, and assessment) and below 4 times with 36 unique keywords.

Table 1

Top 20 high frequency keywords (frequencies above 10)

Occurrence freq.	Keyword	Occurrence freq.	Keyword
51	Extensive reading	16	EFL learners
48	Reading comprehension	15	Assessment
32	Vocabulary learning	15	Graded readers
25	Reading instructions	14	Vocabulary knowledge
22	Reader characteristics	14	Reading materials
21	Reading fluency	13	Motivation
21	Foreign LoE	11	Language proficiency
21	Reading strategies	10	Tests
18	Reading rate	10	Reading processes

| 16 | EFL | 10 | Occurrence rate |

Reading comprehension was the second most frequently researched topic with an occurrence of 48 times accounting for 6.4% of the total 750 frequencies. It co-occurred with reading rate most frequently (8 times), followed by reading fluency (7), extensive reading (6), and data elicitation methods (6). Furthermore, it co-occurred 5 times with 5 unique keywords (reading strategies, reader characteristics, reading instructions, statistical methods, and reading processes), 4 times with 6 unique keywords (foreign languages other than English, EFL, language proficiency, tests, repeated reading, and text simplification) and below 4 times with 32 unique keywords.

Table 2

Keywords co-occurrence (frequencies above 6)

Co-occurrence	Keyword 1	Keyword 2
12	Extensive reading	Graded readers
12	Reading fluency	Reading rate
11	Extensive reading	Vocabulary learning
9	Extensive reading	Reading fluency
8	Extensive reading	Motivation
8	Reading comprehension	Reading rate
8	Vocabulary learning	Occurrence rate
7	Reading comprehension	Reading fluency
7	Reading fluency	Timed reading
7	Reading fluency	Repeated reading
6	Vocabulary learning	Glosses
6	Extensive reading	EFL
6	Extensive reading	Reading comprehension
6	Extensive reading	Reading instructions
6	Extensive reading	Reading rate
6	Reading rate	Timed reading
6	Data elicitation methods	Reading comprehension

Another constantly researched topic was vocabulary learning (32 occurrences, 4.27% of the overall frequency). It co-occurred most frequently with extensive reading (11), followed by occurrence rate (8), glosses (6). It co-occurred 5 times with 3 unique keywords (text coverage, reading instructions, and vocabulary knowledge), and below 4 times with 31 unique keywords. Reading instructions was another highly researched topic (25 occurrences, 3.33% of the total frequency 750). It co-occurred mostly frequently with extensive reading (6), followed by vocabulary learning (5), reading comprehension (5), reading strategies (4), and below 4 times with 35 unique keywords. Finally, among these 20 most frequent keywords were reader characteristics (22, 2.93% of 750), reading fluency (21, 2.80%), foreign languages other than English (21, 2.80%), and reading strategies (21, 2.80%).

Reader characteristics co-occurred most frequently with foreign languages other than English (5), and vice versa. Reading strategies co-occurred most frequently with foreign languages other than English (5). In contrast, reading fluency shares higher co-occurrence frequency with other topics. It co-occurred most frequently with reading rate (12), followed by extensive reading (9), timed reading (7), and repeated reading (7).

How Frequently Researched Topics were Clustered Structurally?

The structure of frequently researched topics was explored by the cluster analysis. The dendrogram of cluster analysis showed that the 50 high frequency words were divided into 8 clusters (see Figure 1). Cluster 1 included four keywords, namely, timed reading, reading fluency, reading rate and repeated reading. These keywords centered on development of reading fluency. Timed reading and repeated reading are typical methods to improve reading fluency and reading rate is an index of reading fluency.

Figure 1

Cluster Dendrogram
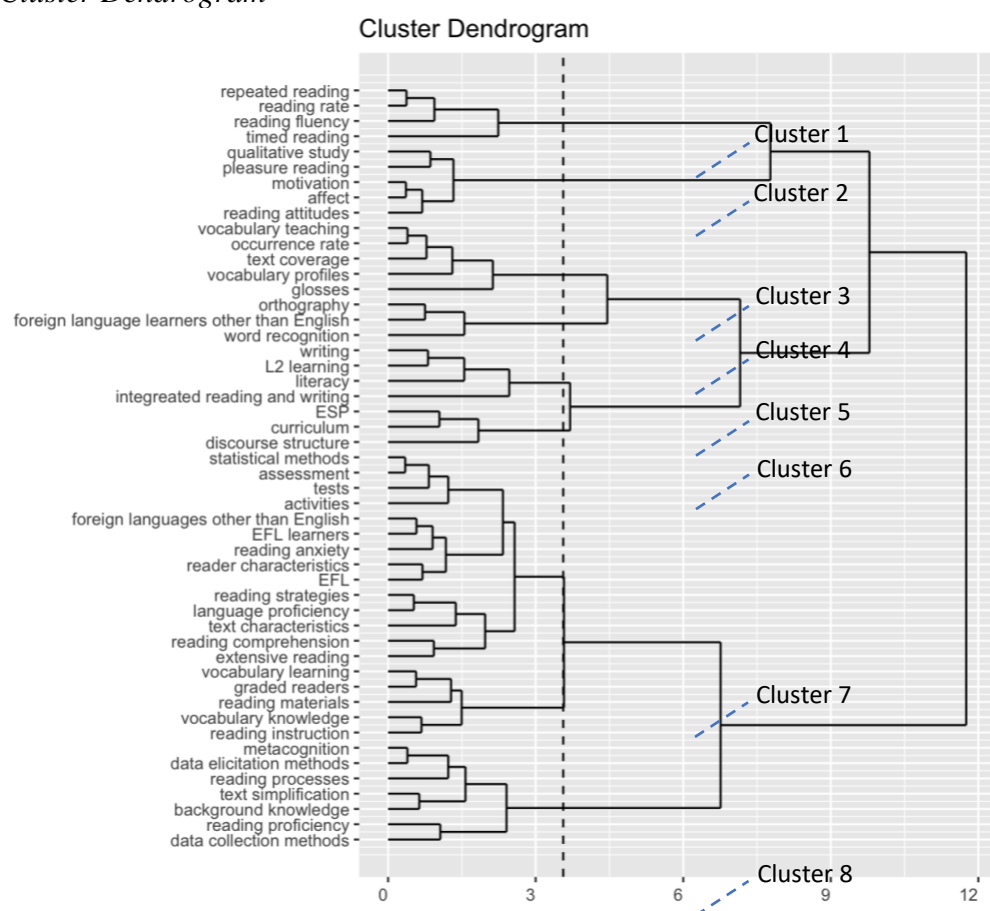
Cluster 2 comprised five keywords, namely, reading attitudes, affect, motivation, pleasure reading, and qualitative study. Most of these keywords revolved around affect. Cluster 3 consisted of five keywords (i.e., glosses, vocabulary profiles, text coverage, occurrence rate, and

vocabulary teaching). These keywords pivoted around vocabulary. Cluster 4 included three keywords, i.e., word recognition, foreign languages other than English, and orthography. The topics of word recognition and orthography were often researched within the domain of foreign languages other than English in the collected literature. Cluster 5 was composed of 4 keywords, which were integrated reading and writing, literacy, L2 learning, and writing. These keywords revolved around the topic of reading and writing in L2 learning. Cluster 6 consisted of three keywords, that is, discourse structure, curriculum and ESP. Cluster 7 comprised 19 keywords, for instance reading instructions, vocabulary knowledge, reading materials, graded readers, vocabulary learning, etc. These keywords did not revolve around a certain topic but covered a variety of topics. The pattern of this cluster was different from that of cluster 1, which centered clearly on one research topic. Cluster 8 was composed of seven keywords, which were data collection methods, reading proficiency, background knowledge, text simplification, reading processes, data elicitation methods, and cognition. The pattern of this cluster was similar with that of cluster 7 where several topics were loosely structured.

How Frequently Researched Topics were Connected?

The connections among frequently researched topics were examined through the keyword connection network by the Ucinet software. As shown in Figure 2, six large nodes were identified, (1) extensive reading; (2) reader characteristics; (3) reading fluency; (4) reading comprehension; (5) vocabulary learning; and (6) reading instructions. Among these six nodes, extensive reading was closely connected with reader characteristics and reading fluency. Around the node of extensive reading were graded readers, occurrence rate, pleasure reading, reading materials, and reading proficiency, which indicated that extensive reading was closely connected with these topics. The second large node, reader characteristics, was linked with motivation, reading attitudes, reading anxiety, background knowledge, and affect. The third large node, reading fluency, was connected to repeated reading, timed reading, and reading rate.

The remaining three nodes, i.e., reading comprehension, vocabulary learning, and reading instructions constituted the second cluster. The fourth node, reading comprehension, was linked with reading strategies, cognition, and glosses. The fifth node (i.e., vocabulary learning) was connected to word recognition, orthography, vocabulary knowledge, vocabulary teaching, and vocabulary profiles. The sixth node (i.e., reading instructions) was connected to curriculum.

In addition to the six large nodes, small nodes could also be clustered. Nodes of language proficiency, EFL learners, EFL, foreign languages other than English, foreign language learners other than English could be clustered together. Similarly, nodes of text characteristics, text coverage, discourse structure and text simplification resided relatively densely within a certain area. The same pattern was observed for nodes of tests, assessment, statistical methods, data elicitation methods, methods of reading research, literacy, and qualitative study. Conversely, nodes such as L2 learning, writing, ESP, integrated reading and writing, reading processes, and activities were rather loose, showing that they were not closely connected with other topics.

Figure 2

Keywords connection network
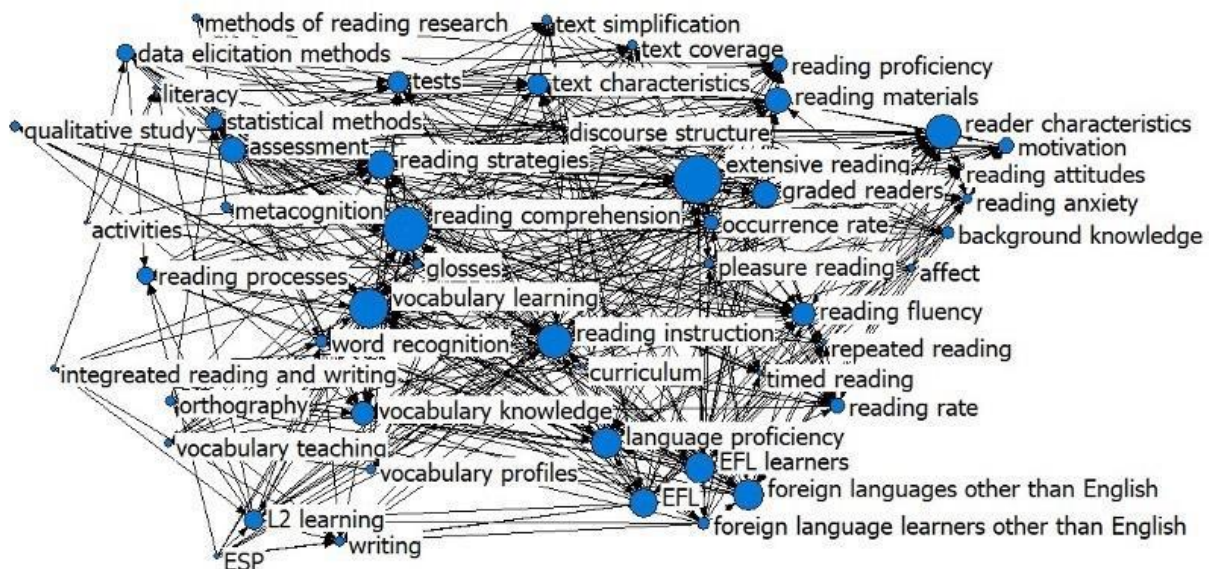
Discussion

To systematically review research topics of *RFL* in the past two decades, this study addressed three questions: (1) what topics were explored most frequently as revealed by author keywords frequency, (2) how frequently researched topics were structurally clustered as revealed by the hierarchical cluster analysis based on author keywords co-occurrence, and (3) how these topics were connected as revealed by author keywords centrality. The present study found that the most frequently researched topics were extensive reading, reading fluency, reading comprehension, vocabulary learning, reading instructions, and foreign languages other than English.

In response to the first research question, extensive reading was the most frequently researched topic in the past decades. It was also closely related to reading fluency, reading comprehension, motivation, vocabulary learning, and graded readers. Results indicate that extensive reading, supported by graded readers, was frequently used to promote reading fluency and vocabulary knowledge. This finding suggests that reading researchers deeply understand the essential role of extensive reading and implicitly practice the principle that students can only master reading abilities by reading and reading extensively (Grabe& Stoller, 2011, p. 173; Day & Bamford,

2002). For instance, Hitosugi & Day (2004), Robb & Kano (2013), and Boutorwick et al. (2019) employed extensive reading to improve foreign language learning. However, most reading programs do not involve adequate reading time (Nation & Waring, 2020). Given this situation, *RFL* contributes to the promotion of the critical role of extensive reading in foreign language learning.

Reading fluency was another frequently researched topic which was closely connected with reading rate, timed reading, and repeated reading. Timed reading and repeated reading are typical methods to improve reading fluency while reading rate is commonly employed to measure reading fluency. Researchers repeatedly reported substantial gaps between L1 and L2 reading rates and estimated that even L2 university students may only read at one-third the rate of L1 readers (Fraser, 2007; Grabe, 2009). This earlier estimation still rings true today. Nation & Waring (2020) reported that a skilled reader reads around 250–300 words per minute (wpm) (p. 158) while the average reading speed of non-native English speakers was around 150 wpm, which was basically half the speed of skilled readers (p. 170). The average reading speed of non-native English speakers is far below that of L1 readers. Thus, programs of reading fluency are indispensable for improving reading abilities of foreign language readers.

Vocabulary learning was another highly researched topic and co-occurred with extensive reading, graded readers, occurrence rate, and glosses. Although they co-occurred, relationships between vocabulary learning and its co-occurred keywords were different. Extensive reading may serve as a method to promote vocabulary learning. Graded readers provide quality reading materials for vocabulary learning. Occurrence rate and glosses of words may influence the outcome of vocabulary learning (Nation & Waring, 2020). Their impact was also revealed in the meta-analyses of Uchihara et al. (2019) and Yanagisawa et al. (2020). Finally, regarding the first research question, foreign languages other than English is also one of the most frequently researched topics. *RFL* has covered research on languages such as Chinese, Italian, Spanish, Japanese, French, Russian, Arabic, Korean, Norwegian, Irish, and Turkish. This shows that *RFL* has attempted to incorporate studies on reading of a wide scope of languages.

The second research question examined how frequently researched topics were organized into groups as revealed by the hierarchical cluster analysis based on author keywords co-occurrence. The steps of the cluster analysis are as follows: (i) keyword co-occurrence matrix; (ii) similarity matrix; (iii) distance matrix between two keywords; and (iv) dendrogram (see Figure 1). Two keywords can be grouped together if the distance is small. The new group can be clustered further with another keyword. The themes of eight identified big clusters include development of reading fluency, learner factors (e.g., attitudes, motivation), vocabulary, foreign languages other than English, integrated reading and writing in L2 learning, and three clusters with loosely related topics. This finding indicated that *RFL* covered a broad reading research scope, and it served as an excellent source of information regarding issues in foreign language reading and literacy. The interpretation of clustering results deserves caution because the process was only data-driven rather than content-based, and therefore some loosely related topics were grouped together, although that rarely happened. For example, cluster 7 included 19 loosely related keywords, which makes it hard to give it a label. For another example, in cluster 8, metacognition and data elicitation methods were clustered.

The third research question examined the connection network of frequently researched topics as revealed by the author keywords connection network. In this network, extensive reading, reader characteristics (e.g., motivation, reading attitudes), reading fluency, reading comprehension, vocabulary learning, and reading instructions occupied pivotal positions, meaning that they were densely connected with multiple topics. This finding indicated that these variables might be causes or effects of many other related variables. Regarding the pivotal position as the cause of multiple variables, extensive reading generated changes in vocabulary learning (e.g., Nation, 2014), reading attitudes (e.g., Yamashita, 2013), and L2 learning (e.g., Hitosugi & Day, 2004). This finding is of special significance. Regarding the pivotal position as the effect of multiple variables, reading fluency was the result of repeated reading (e.g., Chang, 2012), timed reading (e.g., Gui et al., 2020), and repeated oral reading (Shimono, 2018).

Results yielded by the hierarchical cluster analysis and author keywords connection network are complementary. The former is based on distances between two keywords, while the latter is based on the importance of author keywords (nodes in a network). Two methods revealed some similar results. Both showed that reading fluency, vocabulary, and reader variables were frequently explored topics in *RFL*. However, they also yielded some different results. The hierarchical cluster analysis did not show extensive reading as a cluster, but the keywords connection network revealed that it is an important node in the network. Examining research topics by two approaches may generate balanced conclusions.

Conclusion

Via the keyword co-occurrence analysis and hierarchical cluster analysis of articles published in *RFL* in the past two decades, this study has identified most frequently researched topics, how these topics are clustered, and how they are connected. The findings of the present study can help readers and potential contributors quickly overview main topics of the journal. The findings have also revealed that the journal has to some degree achieved its declared aims and scopes or its missions, namely, to address issues of learning and teaching of reading in any foreign or second language. *RFL* is an invaluable resource to readers and researchers whose research emphasis is on extensive reading, reading fluency, vocabulary development, graded readers, and reading instructions.

The present study utilized keywords co-occurrence analysis and hierarchical cluster analysis approaches. These bibliometric methods can more objectively capture research topics than approaches based on topic categorization, because studies can hardly be classified under a single category. To deal with the challenge of categorization, Stapleton and Shao (2018) had to put some articles into more than one category (p. 356). Furthermore, co-occurrences of keywords can better reflect relationships between research topics. Instead, studies based merely on occurrence frequencies of categories cannot provide such information.

Related to the advantage of keywords co-occurrence analysis, the present study also revealed that extensive reading frequently co-occurred with seven other keywords, including vocabulary learning, motivation, reading fluency, and reading comprehension. The present analysis uncovered the pivotal function of extensive reading on multiple skills. This finding is of

important pedagogical implications. Teachers need to encourage students to do more extensive reading although it may only have a very small effect on vocabulary, a modest effect on reading fluency, or a trivial effect on comprehension. However, cumulatively extensive reading may lead to improvement on learners' overall foreign language ability (Nation & Waring, 2020).

In addition, the present study revealed five other frequently researched themes in *RFL*, including reader characteristics, reading fluency, reading comprehension, vocabulary learning, and reading instructions. These topics are either complex or crucial to the development of reading ability in a foreign language, and they deserve further investigation. For example, investigation into reader characteristics may shed further light on the dynamic interactions between reader and text. For another instance, reading fluency has been frequently examined but deserves further research because the problem of slow reading rates is widespread among L2 learners (Grabe, 2010). There exists a substantial gap between L1 and L2 reading rates (Chang & Millett, 2015; Fraser, 2007; Grabe, 2009; Suk, 2017).

The findings of the present study have some pedagogical implications. First, considering that extensive reading co-occurred with many other keywords, teachers should encourage students to read extensively. The effect might seem slight when merely one sub-skill (e.g., vocabulary) is examined. However, its influence permeates the whole system of reading and even beyond, such as writing and learning motivation. Second, teachers need to be aware of multiple possible instructional techniques and employ them flexibly when they focus on a specific teaching target. For example, to improve students' reading fluency, teachers need to employ extensive reading, repeated reading, and timed reading approaches according to specific instructional contexts.

Overall, the complex network of reading in a foreign language revealed in this study might shed new light on reading pedagogy. Relationships among various factors related to reading should not be simplified when teachers evaluate effects of reading or when they design activities to improve L2 reading ability.

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