Early language learning. A bibliometric analysis of the most influential articles (2010-2022)

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ABSTRACT: The aim of this article is to analyse the evolution of research on language learning at early ages within the main collection of the Web of Science (2010 to 2022) and Scopus (2010 to 2022). To this end, a bibliometric study has been developed taking into consideration the following indicators: diachronic, geographical, authors and source productions. At the same time, an analysis of the structural development of the topics has been carried out on a sample of references from combined searches. The analyses carried out determine an exponential growth pattern in the scientific literature on early language and learning over the last two decades (2010-2022), a period that covers 87.2% of the current scientific production. In relation to the evolution of topics in the field, it is observed that current lines of research are focusing mainly on the results obtained in two areas: (1) Neurosciences and Speech Pathologies and (2) Psychology, Social Sciences and Technology, where the value of A/Y where higher, which indicates that both areas are the ones that have the greatest influence over time.
Keywords: Early Language Learning, Bibliometrics analysis, Foreign languages, Plurilingualism, Pre-primary education

Aprendizaje de las lenguas en edades tempranas. Análisis bibliométrico de los artículos más relevantes (2010-2022)

RESUMEN: El objetivo de este artículo es el análisis de la evolución en la investigación del aprendizaje de las lenguas en edades tempranas en la Web of Science (2010 a 2022) y Scopus (2010 a 2022). Se ha realizado un estudio bibliométrico teniendo en cuenta los siguientes indicadores: diacrónico, geográfico, autores e institución de donde proceden sus producciones. Igualmente se ha realizado un análisis del desarrollo estructural de los temas de la muestra de referencias de las búsquedas combinadas.
Los análisis realizados determinan un patrón de crecimiento exponencial en la literatura científica en el aprendizaje y las edades tempranas en las dos últimas décadas (2010-2022), un periodo que cubre el 87,2% de la producción científica actual. En cuanto a la evolución de los temas investigados en el campo, se observa que las tendencias actuales se enfocan mayormente en dos áreas: (1) Neurociencias y patologías del lenguaje y (2) Psicología, ciencias sociales y tecnología, donde el valor A/Y son más altos, indicando que ambas áreas son las que mayor influencia en tienen en el tiempo.
Palabras clave: aprendizaje de lenguas en edades tempranas, análisis bibliométrico, lenguas extranjeras, plurilingüismo, educación infantil en lenguas extranjeras

1. Introduction

Early Language Learning (ELL) at pre-primary level means systematic awareness raising or exposure to more than one language taking place in an early childhood education and care setting in a pre-primary school context (Council Recommendation on a Comprehensive Approach to the Teaching and Learning of Languages, 2019; European Strategic Framework for Education and Training; 2011). Interest in foreign language learning through early childhood education and care has grown in many countries (Bergström et al., 2016; Ferjan Ramírez & Kuhl, 2020), encouraged by possible long-term benefits of an earlier start (Conger et al., 2019; European Commission, 2018; Hakuta et al., 2003; Hyltenstam & Abrahamsson, 2001; Jaekel et al., 2022; Myles, 2017; Paradis & Jia, 2016;). Furthermore, from ages 0 to 6, 70% of the mental development of children seems to be completed, especially language development (Becker & Roos, 2016; Erkan & Kırca, 2010; Garner & Waajid, 2012), true that theories of brain plasticity are not conclusive and the age debate is still open (Pfenninger & Singleton, 2021).

Research into age-related differences coincide in highlighting that successful second language learning depends on a combination of the age of the learner together with social, psychological and pedagogical factors: time and intensity of the second language input (Bergström et al, 2016), teacher´s second language competence (Marinova-Todd, Marshall & Snow, 2000; Bowers and Vasilyeva, 2011) and types of activities used in the class (Rixon, 2013) or features such as the quality of the L2 input they are exposed to (Thieme, 2022; Weitz et al, 2010), the ways in which the foreign language input is organised - for example in terms of activities, times of the day, and speakers (Thieme et al., 2022) and the frequency of use and exposure in and out of school (Coyle & Férez Mora, 2018; Ojima, et al., 2011).

Furthermore, learning a second language at early ages enhances communication awareness in the first language (Cummins, 1979) and can contribute to the development of positive attitudes towards other languages and cultures by raising awareness of diversity and cultural variety (European Commission, 2018, 2023).

Thus, an early start contributes to sustainability of language skills in a lifelong learning perspective (Deveci, 2015; European Commission, 2011; Kohler, 2017; Wei & Weerasawainon, 2022). However, as the European Commission (2020) states, a supportive environment is essential for a beneficial ELL, calling on relevant stakeholders to be part of it: families, authorities, staff and education and training providers. Teaching a second language to very young children implies a challenging task for teachers (Albaladejo, Coyle, & Roca de Larios, 2018), which includes keeping the children´s motivation for learning high while fostering their developing cognitive and linguistic skills. So, teachers play a very important role (Brooks & Murray, 2018; Sembiante et al., 2022) as they provide enriching, engaging environments, learning opportunities (scaffolding, play, challenge solving) using early childhood pedagogies and monitoring the learning progress using formative assessment.

A growing body of studies recognise the benefits of ELL, nevertheless there are not many studies focused on deep bibliometric analysis explaining tendencies, topics of interest or important aspects in the field. As Jiménez-Jiménez et al. (2023) state, the complete bibliometric analysis thus becomes a key tool for evaluating ongoing actions and research and thus, disseminating their results. Bibliometrics help the qualitative analysis of research results by using bibliometric indicators of diverse areas and disciplines. Bibliometric tools

allow finding and analysing highly cited publications or top cited publications to identify tendencies or interest topics in several areas of research. All through the years bibliometric indicators have been created to evaluate the quality of scientific publications and journals, the impact factor and the immediacy index.

Metrics of journals and authors are not fully reliable in terms of quality and impact of publications. The most widely used method to measure validity and quality of publications has been the number of citations (Moed, 2010). Bibliometric tools allow finding and analysing highly cited publications or top cited publications to identify tendencies or interest topics in several areas of research. However this measuring tool could be limiting as for example self-citations, depending on the area of expertise and closely connected to year of publication, so those publications that are older are ahead more recently published research (Garfield, 1989). This fact makes finding tendencies difficult and new indicators time-normalized are needed (Hutchins, 2016; Gasparyan, 2021).

These indicators are used in some data bases as for example in iCite, a bibliometric tool of PubMed that has some metrics which allow to normalise by category and time as relative citation rate and citation per year (iCite, 2021). Web of Science has also introduced Average per Year, a metric obtained dividing the number of citations of an article by the total of years since its publication, and that shows the importance of an article through the years. These indicators have been used in other areas non related to ELL and closer to medicine (Valderrama et al., 2022; Bornmann & Haunshild, 2017) or even in other areas of education (Valderrama & Solana, 2022). Bibliometrics has benefited from new software such as VOSviewer, a tool for building and visualizing bibliometric networks based on citation, bibliographic linkage, co-citation, or co-authorship relationships (Van Eck & Waltman, 2010).

Recent studies have used applied bibliometrics to the field of language learning (Karakaya & Bozkurt, 2022), others even used VOSviewer (Hou & Yu, 2023). As of the field of ELL, we can mention the bibliometric study by Meryem Yilmaz and Takkaç (2022) about foreign language teaching in pre-primary schools by mapping analysis. More recently, the study by Jiménez-Jiménez (2023), which analyses ELL publications from the bibliometric point of view. As far as our knowledge, recent tendencies have not been analysed based on identifying the most important articles. So, our objective is to identify, classify and identify developmental tendency in the research of the 100 top ELL articles from 2010 to 2022, using an indicator based on citations and time-normalized, Average per Year.

2. Material and methods

2.1. Search strategy, data extraction and citation metrics

A cross-sectional bibliometric study was undertaken, looking for ELL with the highest Average per year (A/Y). The terms and search strategy were performed by two researchers with experience in the topic and bibliometrics.

On February 21, 2023, a Web of Science Core Collection (Clarivate Analytics) advance search was performed with the following strategy:

(((((((((AB=(“early years”)) OR AB=(pre-primary)) OR AB=(“PreK education”)) OR AB=(pre-K)) OR AB=(“pre-kindergarden”)) OR AB=(Plurilingualism)) OR AB=(pluricultur-

alism)) OR AB=(early childhood)) OR AB=(early language learning)) OR AB=(ELL) AND (AB=(Foreign languages)) OR AB=(second language)

The publications obtained, from 2010 to 2022, were 1929. On the page of results, the "Citation report" section was accessed, where the "Average per Year" and "citations" metrics were retrieved. The documents were ranked in a descending order according to A/Y and they were independently assessed by two researchers (NM and FT) to confirm that the main focus was ELL. A total of 27 documents were eliminated because they did not fit the topic, which allowed us to select the top 100 articles with the highest A/Y.

Each article was evaluated by metrics of influence A/Y and the number of citations. Moreover, they were assessed considering the following characteristics: year of publication, journal, number of authors and country, gender and institution of origin of the first author; as well as of the authors and co-authors. All documents were also characterized by the research area by the same two researchers; and in the event of disagreement between the two, a unanimous decision had to be made. The research areas were: 'Neurosciences and Speech Pathologies', 'Education & Educational Research', 'Linguistics' and 'Psychology, Social Sciences and Technology'.

Of the 100 articles with the highest A/Y and from the Web of Science in plain text, the information was loaded into the VOSviewer 1.6.17 software (Center for Science and Technology Studies, Leiden University, The Netherlands; available at https://www. vosviewer. com, accessed on March 13, 2023). VOSviewer is a software tool for building and visualizing bibliometric networks based on citation, bibliographic linkage, co-citation, or co-authorship relationships. It was used to process the data by building a map of bibliographic networks based on the co-occurrence of keywords of the articles.

2.2. Statistical analysis

The Shapiro-Wilk test was used to test the Gaussian property of A/Y and number of citations. As the data were not assumed to be normal, to compare these metrics among periods (2010-2015 and 2016-2022) as well as gender (female and male), a non-parametric Mann-Whitney test was used. The U statistics is then calculated as the minimum of

$$U_1 = n_1 n_2 + \frac{n_1 (n_1 + 1)}{2} - R_1$$
$$U_2 = n_1 n_2 + \frac{n_2 (n_2 + 1)}{2} - R_2$$

where n1 and n2 are the respective sizes of each sample; R1 and R2 is the sum of the ranks (the sum of the relative position of each individual in the sample) of the observations of samples 1 and 2, respectively.

In order to compare these metrics according to years and the four research areas, a Kruskal-Wallis test was performed by evaluating the following statistics:

$$H = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(n+1)$$

being Ri the sum of the ranks of each one of the k groups, n_i the sample size of the group i, and n=n1+n2+⋯+nk the total size sample.

Statistical analysis was performed using SPSS version 23, licensed by University of Granada. The significance level was set at $p<0.05$.

3. Results

Table 1 presents the 20 most relevant publications ranked by their A/Y, as well as the A/Y value and number of citations. In Supplementary Materials, Table S1 shows all 100 articles.

Table 1. *The 20 most influential ELL articles ranked according to the Average per year (A/Y). 2010-2022*

A/Y Rank	Reference	A/Y	No. Cites
1	Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18months. *Developmental Science*, *16*(2), 234–248. https://doi.org/10.1111/desc.12019	58.55	644
2	Kuhl, P. K. (2010). Brain Mechanisms in Early Language Acquisition. *Neuron*, *67*(5), 713–727. https://doi.org/10.1016/j.neuron.2010.08.038	26.43	370
3	Hammer, C. S., Hoff, E., Uchikoshi, Y., Gillanders, C., Castro, D. C., & Sandilos, L. E. (2014). The language and literacy development of young dual language learners: A critical review. *Early Childhood Research Quarterly*, *29*(4), 715–733. https://doi.org/10.1016/j.ecresq.2014.05.008	18.3	183
4	Sullivan, A., & Bers, M. U. (2016). Robotics in the early childhood classroom: Learning outcomes from an 8-week robotics curriculum in pre-kindergarten through second grade. *International Journal of Technology and Design Education*, *26*(1), 3–20. https://doi.org/10.1007/s10798-015-9304-5	16.88	135
5	Piller, I., & Gerber, L. (2021). Family language policy between the bilingual advantage and the monolingual mindset. *International Journal of Bilingual Education and Bilingualism*, *24*(5), 622–635. https://doi.org/10.1080/13670050.2018.1503227	15	45
6	Kayi-Aydar, H. (2015). Teacher agency, positioning, and English language learners: Voices of pre-service classroom teachers. *Teaching and Teacher Education*, *45*, 94–103. https://doi.org/10.1016/j.tate.2014.09.009	14.89	134
7	Lamb, M. (2017). The motivational dimension of language teaching. *Language Teaching*, *50*(3), 301–346. https://doi.org/10.1017/S0261444817000088	13.71	96
8	Birdsong, D. (2018). Plasticity, Variability and Age in Second Language Acquisition and Bilingualism. *Frontiers in Psychology*, *9*, 81. https://doi.org/10.3389/fpsyg.2018.00081	12.33	74
9	Paradis, J., & Jia, R. (2017). Bilingual children's long-term outcomes in English as a second language: Language environment factors shape individual differences in catching up with monolinguals. *Developmental Science*, *20*(1), e12433. https://doi.org/10.1111/desc.12433	11.29	158
10	DeKeyser, R., Alfi-Shabtay, I., & Ravd, D. (2010). Cross-linguistic evidence for the nature of age effects in second language acquisition. *Applied Psycholinguistics*, *31*(3), 413–438. https://doi.org/10.1017/S0142716410000056	9.5	133

11	Wang, S., & Vasquez, C. (2012). Web 2.0 and Second Language Learning: What Does the Research Tell Us? *Calico Journal*, *29*(3), 412–430. https://doi.org/10.11139/cj.29.3.412-430	9.42	113
12	Butler, Y. G. (2015). English language education among young learners in East Asia: A review of current research (2004-2014). *Language Teaching*, *48*(3), 303–342. https://doi.org/10.1017/S0261444815000105	8.78	79
13	Begus, K., Gliga, T., & Southgate, V. (2016). Infants' preferences for native speakers are associated with an expectation of information. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(44), 12397–12402. https://doi.org/10.1073/pnas.1603261113	8.63	69
14	Westlund, J. M. K., Jeong, S., Park, H. W., Ronfard, S., Adhikari, A., Harris, P. L., DeSteno, D., & Breazeal, C. L. (2017). Flat vs. Expressive Storytelling: Young Children's Learning and Retention of a Social Robot's Narrative. *Frontiers in Human Neuroscience*, *11*, 295. https://doi.org/10.3389/fnhum.2017.00295	8.14	57
15	Munoz, C. (2014). Contrasting Effects of Starting Age and Input on the Oral Performance of Foreign Language Learners. *Applied Linguistics*, *35*(4), 463–482. https://doi.org/10.1093/applin/amu024	7.8	78
16	Seidl, A., & Cristia, A. (2012). Infants' learning of phonological status. *Frontiers in Psychology*, *3*, 448. https://doi.org/10.3389/fpsyg.2012.00448	7.75	93
17	Paradis, J., & Kirova, A. (2014). English second-language learners in preschool: Profile effects in their English abilities and the role of home language environment. *International Journal of Behavioral Development*, *38*(4), 342–349. https://doi.org/10.1177/0165025414530630	7	49
18	Brenders, P., van Hell, J. G., & Dijkstra, T. (2011). Word recognition in child second language learners: Evidence from cognates and false friends. *Journal of Experimental Child Psychology*, *109*(4), 383–396. https://doi.org/10.1016/j.jecp.2011.03.012	5.77	75
19	Granena, G. (2013). Individual Differences in Sequence Learning Ability and Second Language Acquisition in Early Childhood and Adulthood. *Language Learning*, *63*(4), 665–703. https://doi.org/10.1111/lang.12018	5.73	63
20	Theoharis, G., & O'Toole, J. (2011). Leading Inclusive ELL: Social Justice Leadership for English Language Learners. *Educational Administration Quarterly*, *47*(4), 646–688. https://doi.org/10.1177/0013161X11401616	5.69	74

With regard to the top 100 A/Y, the mean (standard deviation) respect to numbers of authors/article was 2.84 (1.82) with a minimum of 1 and maximum of 13. If we focus on the gender of the first author, there is a majority of females against males (72 versus 28), however, the difference doesn't prove significant for A/Y (p=0.933) and citations (p=0.514).

The highest number of articles published in a single year was fourteen in the years 2011 and 2014, followed by twelve in 2018 and eleven in 2017. The lowest number of articles corresponds to 2022 with 2 publications.

Bibliometric characteristics are gathered in Table 3, globally and by two periods, 2010-2015 and 2016-2022. The A/Y and number of citations show statistically significant differences among the periods with fewer values in 2016-2022.

Table 2. *Metrics of the top 100 most influential Early language teaching articles, with the highest Average per year (A/Y): 2010 – 2022*

	2010-2022 n=100	2010-2015 n=54	2016-2022 n=46	Comparison *p*-value*
Average per Year[a]	3 (3.60)	3.82 (3.47)	1.93 (2.76)	
Min-Max	0.43-58.55	0.43-58.55	0.83-16.88	0.014
Weighted A/Y	478.38	311.80	166.58	
Citations[a]	26.50 (44)	41.50 (44)	9.50 (17)	
Min-Max	5-644	6-644	5-135	<0.001
Total Citations	4.577	3.588	989	

[a] Median (interquartile range). Min - Max: Minimum and Maximum values. Weighted A/Y: sum of the Average per year for the articles in the group.
* Mann-Whitney test, previously the Shapiro-Wilks test showed no normality

The frequency of the articles according to their research area, as well as the weighted A/Y and total citations are shows in Table 3, including mean per article, and the median (interquartile range). The global comparison of these two variables did not show significant differences for either of two metrics.

Table 3. *Research area of the top 100 most influential Early language teaching articles, with the highest Average per year (A/Y): 2010 – 2022. Average per Year and Citations: Weighted A/Y (mean per article), total citations (mean per article) and Median (interquartile range*)

		Average per Year		Citations	
Research area	**n**	**Weighted A/Y (mean/article)**	**Median (IR)**	**Total (mean/article)**	**Median (IR)**
Neurosciences and Speech pathologies	11	74.31 (6.76)	4.29 (5.64)	861(78.27)	45(30)
Education & Educational Research	48	205.5 (4.28)	2.29 (3.67)	1692 (35.50)	20.50 (36)
Linguistics	16	48.19 (3.01)	1.80 (3.11)	483(30.18)	30.19 (41)
Psychology, Social Sciences and technology	25	150.38 (6.02)	3.79 (2.74)	1541 (61.64)	39 (45)
Comparison p-value*			0.074		0.051

Weighted A/Y: sum of the Average per Year for the articles of each research area. Mean/article: Mean per article.
*Global comparison by Kruskal-Wallis test. Data not following normal distribution by Shapiro-Wilk test.

Figure 1 shows the frequency of the articles according to their research area in two periods (2010-2015 and 2016-2022). The area with the highest number of articles is Education & Educational Research (n=23 in 2010-2015 and n=25 in 2016-2022) followed by Psychology, Social Science and technology (n=16 in 2010-2015 and n=9 in 2016-2022).

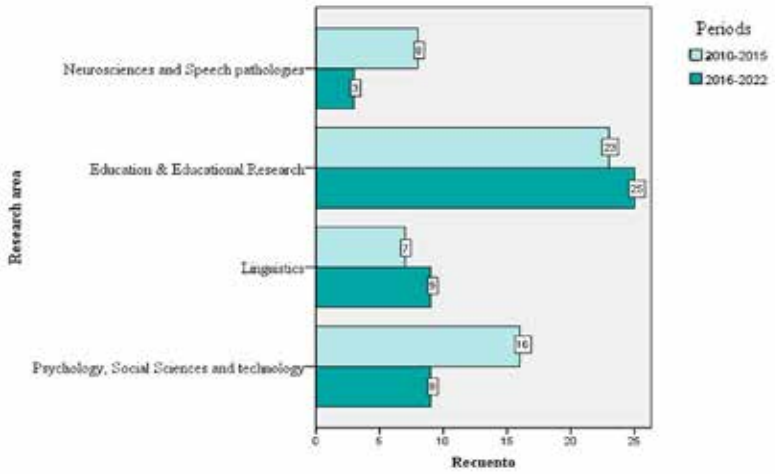

Figure 1. *Association between the research area and periods of time of the 100 Early language learning articles with the highest Average per Year*

A total of 76 Institutions contributed to the top 100 A/Y articles. The University of Toronto and California State University System were the best represented, publishing four articles, followed by the Universities of Washington, Alberta, Texas System and Radboud University Nijmegen with 3. Table 4 displays the institutions that put out at least two articles, as well as its frequency and weighted A/Y.

Table 4. *Institutions that contributed at least two articles to the top 100 most relevant ELL/ teaching articles with the highest Average per Year. 2010-2022*

Rank	Institutions	Frequency	Weighted A/Y
1	University of Toronto	4	19.02
2	California State University System	4	10.59
3	University of Washington	3	35.8
4	University of Alberta	3	22.55
5	University of Texas System	3	20.31
6	Radboud University Nijmegen	3	13.18
7	Pennsylvania Commonwealth System of Higher Education (PCSHE)	2	23.3
8	Macquarie University	2	17.08
9	University System of Maryland	2	15.41
10	State University System of Florida	2	13.42
11	University of Pennsylvania	2	13.18
12	University of Pecs	2	7.46

13	University of Queensland	2	6.42
14	University of Macau	2	6
15	Pennsylvania State System of Higher Education (PASSHE)	2	5.08
16	University College Dublin	2	3.6
17	Universidad Católica de Murcia	2	2.93
18	University of Southern Denmark	2	2.67
19	University of California System	2	2.39

Among the 50 journals represented, the International Journal of Bilingual Education and Bilingualism had the largest number of publications (n=6), followed by Early Childhood Education Journal and Frontiers in Psychology with n=4. The Table 5 gathered the journal with at least two articles.

Table 5. *Journals that contributed at least two articles to the top 100 most relevant ELL articles with the highest Average per Year (A/Y). 2010-2022*

Publication Titles	No of Articles	Weighted A/Y	Total citations
International Journal of Bilingual Education And Bilingualism	6	26.08	158
Early Childhood Education Journal	4	11.11	73
Frontiers in Psychology	4	24.58	185
Journal of Communication Disorders	3	21.08	243
Journal of Experimental Child Psychology	3	12.1	131
Language Learning	3	9.36	81
Language Teaching	3	24.49	181
Applied Linguistics	2	9.4	94
Applied Psycholinguistics	2	13.42	184
Bilingualism Language and Cognition	2	2.39	13
Developmental Science	2	65.55	693
Early Child Development and Care	2	3.57	25
Early Childhood Research Quarterly	2	21.45	224
European Early Childhood Education Research Journal	2	2.22	16
Journal of Educational Psychology	2	8.15	82
Language Awareness	2	4.28	36
Preschool bilingual education agency in interactions between children, teachers and parents* (book)	2	2.83	17
Reading and writing*	20	6.94	92

*These Journals are not included in Journal Citation Reports.

A total of 265 authors contributed to the top 100 A/Y articles. Number one author is Patricia Kuhl, with four articles, followed by Johanne Paradis with 3 publications. A total of 17 authors published two articles, and 248 contributed with one. Figure 2 shows the authors who published at least two articles, their frequency (a), weighted A/(Y (b), and total citations (c).

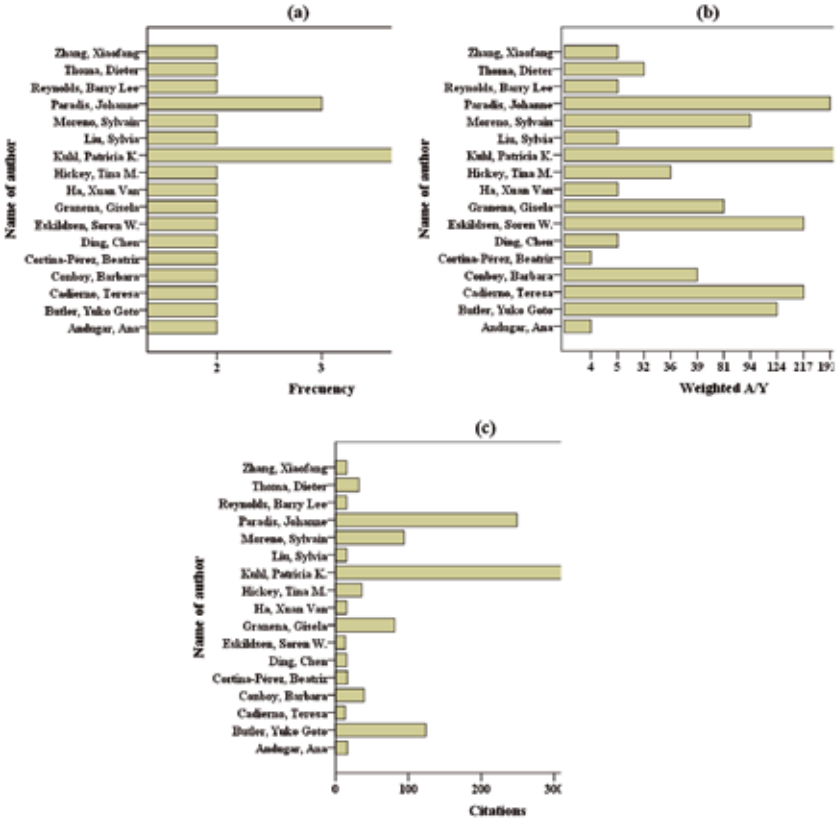

Figure 2. *Authors of two or more articles of the 100 ELL articles with the highest A/Y. (a) Frequency, (b) weighted Average per Year (sum of the Average per Year for the articles of each author), and (c) total citations*

Of the 100 main A/Y articles, a total of 634 keywords were identified and having two or more co-occurrences, 145 nodes met the limit grouped in nine clusters and 1408 links (total bond strength 1667) (Figure 3). The most frequently occurring keywords were "acquisition" (n = 19), "English" and "language" (n = 18), "bilingualism" (n = 14), "children", "vocabulary" (n = 12), "phonological awareness" and "teachers" (n = 9), "language development" and "skills" (n = 8), "education" (n=7), "second-language", "second-language acquisition", learners and "performance" (n = 6).

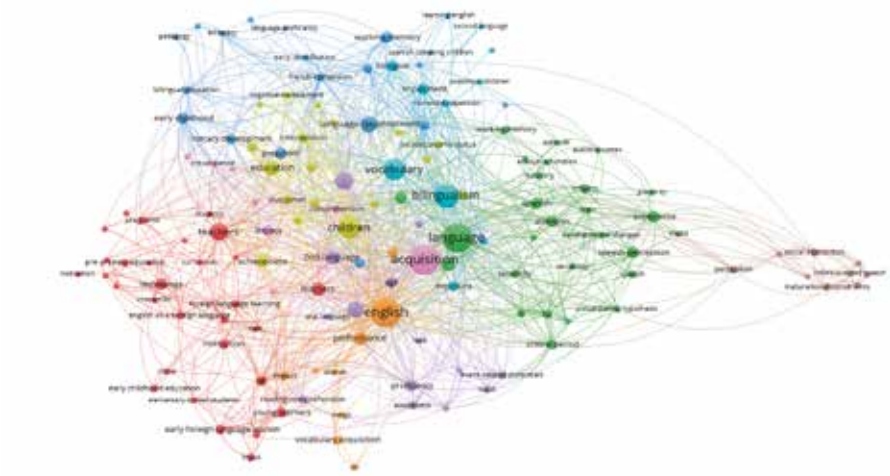

Figure 3. *The network of two or more co-occurring keywords of the 100 articles in ELL. A total of 145 nodes, nine clusters and a maximum of 1408 lines*

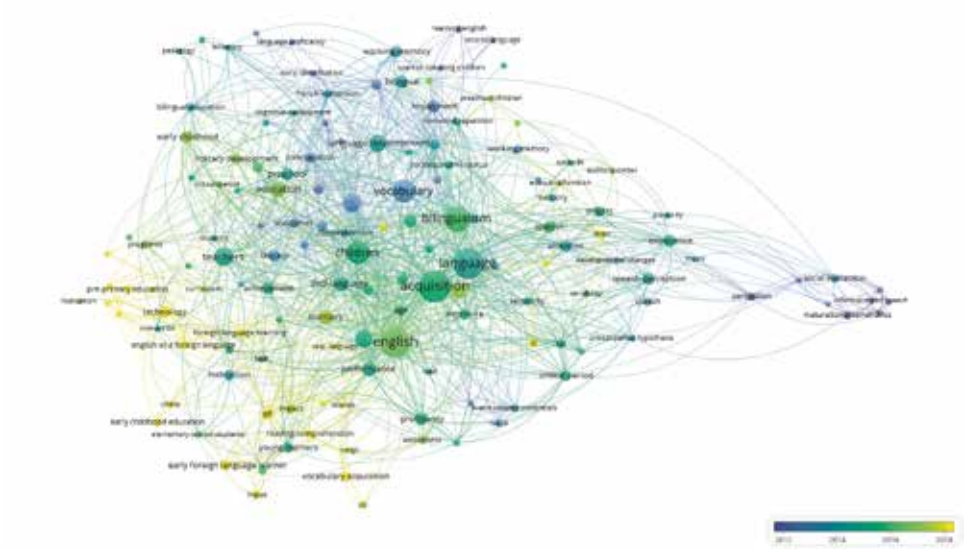

Figure 4. *Visualisation of all keywords with the highest Average per Year with two or more co-occurrences in the period 2010-2022. The yellow colour represents the most recent keywords near 2022, while blue and violet zones belong to oldest keywords. A total 145 nodes, nine clusters and a maximum of 1408 lines. Predominance of blue colour*

Figure 3 shows the network generated based on how the most co-occurring keywords of the top 100 articles present nodes, clusters and lines.

Figure 4 shows a network of keywords by years. The nodes in blue (the oldest keyword) contain keywords such as "vocabulary", "literacy", "comprehension", "infant-directed speech", "second language" and "biliteracy" among others. The turquoise-coloured nodes that correspond to the middle stage of the period studied collect words such as "acquisition", "bilingualism", "language development", "children", "English" and "second-language". In yellow are more recent terms such as "pre-primary education", "foreign language teaching", "technology", "reading comprehension" and "early childhood education".

4. Discussion

This study aimed to determine which articles in the field have played the most noteworthy role, by identifying and analysing their characteristics from a bibliometric point of view.

The interest of the following work, therefore, is focused in identifying current trends, which is why a specific indicator has been used (Average per Year, A/Y). This is an article-level metric, but also normalizes citations by years; it is arguably a significant improvement over other metrics such as citation counts (Surkis & Spore, 2018).

The first three articles with the highest A/Y have been analysed. The first publication, from Stanford University (USA), it has an A/Y of 58.55 and 644 citations (Fernal et al., 2013), and is far above the next in line. This article is about differences in early language proficiency of infants from a variety of advantaged and disadvantaged families, an 18-24-month longitudinal study of real-time measures of spoken language processing. The second article by Kuhl (2013) - A/Y of 26.43 and 370 citations - focuses on young children's early language processing and how ELL is beginning to reveal multiple brain systems that underlie the human language faculty. Four of the 100 articles belong to this author and she has obtained the highest weighted A/Y and Citations. The third article (Hammer et al., 2014) discusses language and literacy development of children who are dual language learners (DLLs) during the early years of childhood. It is interesting to highlight the fact that the three publications deal with topics closely related to the areas of Neurosciences and Speech pathologies and Psychology, Social Sciences and Technology, both with the highest A/Y and total citations (Table 3). From the list of the 100 articles with the highest A/Y analysed, it is interesting to mention the one by Yilmaz et al. (2022), which despite not being among the top, also carried out a bibliometric analysis of the studies on foreign language teaching in pre-school education by mapping analysis using VOSviewer software, in order to release the most used keywords, citation analyses and co-citation analyses.

Using a normalised metric has resulted in a very balanced sample size between the two periods, 54 articles in the first (2010-2015) and 46 articles in the second (2016-2022) period respectively, and obtained a significant representation of recent years. In fact, almost 30% of the articles are from the last 5 years, of which two of them belong to 2022, and reinforces the utility for identifying trends. However, if we compare A/Y values of both periods, we find significant differences ($p=0.014$) with higher values in the first period, even when the metric is time-normalized. Initially these results were not expected compared to results obtained in other areas using time-normalized indicators (Valderrama et al., 2022). This can be explained by the number of citations received, which quadrupled in the first period compared to the second - 3588 versus 989 - and with significant differences ($p<0.001$). In

the short time elapsed, the most recent articles have not been able to compensate for the lower number of citations received, precisely because they are more recent.

Regarding the research area, we encountered influential articles in all categories, though "Education & Educational Research" was most prolific (n=48), almost 50%, although it seems coherent as this area deals with the topics we are analysing and the terms and trends in research. On the contrary, the smallest number of articles corresponds to "Neurosciences and Speech pathologies'' (n=11). This may be because it is an emerging research area. Another relatively underrepresented area is "Linguistics" (n=16). It is interesting to note that when we compare the A/Y (as well as citations), there were no significant differences between areas (Table 3). On the one hand, this could mean that each one of the research areas represents an important topic that is well addressed in early language teaching studies.

However, although without statistical differences, the p values are very close to significance, possibly due to the high dispersion of the data because some values in the interquartile range are higher than the median. Thus, we find the highest values of A/Y and citation in the area "Neurosciences and Speech pathologies'' -median n=4.29 and 45 respectively, despite being an area with such a low number of retrieved publications (n=11), this may be due to the fact that one of the authors with the highest number of publications and the highest weighted Average per Year and citations, Patricia Kuhl, whose publications mainly deal with topics related to Neurosciences. By contrast, Education & Educational Research, with 48 publications, had only a median of 2.29 for Average per Year and the fewest number of citations. These results could be due to the number of articles in each area. The high number of influential articles in "Education & Educational Research" (n=48) has provoked the fact that the citations have been distributed among all of them, reducing the metrics. However, the 11 relevant articles in the "Neurosciences and Speech pathologies" area seem to have monopolised the citations, which could indicate that it is a topic that requires more attention from researchers.

The analysis of the first author position is interesting because it is usually assigned to the person who makes the greatest contribution (Tscharntke et al., 2007). It is noteworthy that when we analyse its gender, women show a clear predominance, 72 compared to 28. This is not surprising since research leadership in this area is assumed mainly by women, contrary to what happens in other areas such as Medicine (Bendels et al., 2018), where men stand out more. However, when the influence metrics between genders are compared, there are no differences, which leads us to believe that the relevance of the articles is not linked to gender.

Of the 50 journals represented, the International Journal of Bilingual Education and Bilingualism stands out with 6 influential publications. This result was expected since it is a specific journal on bilingual education, it has an impact factor of 3.165 in 2021 and it is Q1 in Linguistic (22/195) and Q2 in Education & Educational research (80/270). It is followed by Frontiers in Psychology (n=4), a journal on the rise according to its impact factor (4.232 in 2021), being Q1 in Psychology, Multidisciplinary (35/148), which demonstrates the influence of Psychology in ELL. With the same number of articles and a lower weighted A/Y value is the Early Childhood Education Journal, also a journal on the rise according to its impact factor and ranked in Q4 in Education & Educational Research (207/270), but its aims and scope is specifically adjusted to the topic object of this study.

Of a total of 76 institutions represented, the USA occupies a predominant place (table 4). The California State University System stands out with 4 publications, followed by

Texas System University and Washington with 3 publications. This last institution collects the highest weighted A/Y, because this institution harbours the most prolific author who published more articles, Patricia Kuhl, who obtains a total weighted A/Y of 3443 and 373 citations, and she may be considered a top research specialist in this field. The American predominance is not surprising since a growing scientific interest in the subject has been demonstrated since 2018, with the USA being the country with the highest production (Jiménez Jiménez et al., 2023). It has also been possible to observe a notorious presence of Canadian universities such as the University of Toronto with 4 contributions and Alberta with 3, and Australian ones such as Macquarie University and the University of Pecs, both with 2 contributions.

Finally, keywords are important elements of any research article involving a bibliographic search and can help researchers when exploring search strategies that lead them to retrieve articles or results considered relevant or pertinent. In this study, the most used keywords were "acquisition", "English", "language", "bilingualism", "children", "vocabulary", "phonological awareness", "language development", "skills", "education", "second-language", "second-language acquisition", "learners" and "performance" (Figure 3). Figure 4 shows a data map with keywords with at least two co-occurrences but associates colours to time. The blue colour shows less recent trends with keywords like "cognitive development" or "language proficiency", while the most recent ones are shown in yellow, which is very useful to identify current trends identified with terms as "pre-primary education", "early childhood education", "technology" and "early foreign language learning".

5. Conclusions

The bibliometric approach in this study not only identified influential articles but also provided a nuanced understanding of temporal dynamics, highlighting the utility of time-normalized indicators in capturing recent research trends.

Using time-normalized indicators unveiled recent tendencies, with 30% of articles from 2018-2022, including those published in 2022. This emphasizes the relevance of staying current in early language teaching research. The analysis of A/Y revealed a nuanced temporal shift, with higher values in the earlier period. This unexpected result prompts further exploration into the dynamics of citation patterns, indicating a potential need for a more nuanced understanding of time-normalized metrics.

Patricia Kuhl's dominance in the top articles underscored the importance of her contributions to Neurosciences and Speech pathologies. This finding suggests that certain topics, when explored by prolific authors, can significantly shape the landscape of early language teaching research.

"Education & Educational Research" emerged as the most prolific research area, aligning with the study's focus. Neurosciences and Speech Pathologies, with fewer articles, showcased high citations and A/Y values, signalling it as an emerging and impactful research area. However, the statistical closeness to significance in A/Y values among different areas raises questions about the dispersion of impactful articles across diverse research domains.

The dominance of the International Journal of Bilingual Education and Bilingualism underscores the journal's centrality in shaping the discourse. The prominence of specific institutions, especially in the USA, highlights regional influences that warrant exploration.

The global presence in early language teaching research, with significant contributions from Canadian universities (e.g., University of Toronto, Alberta) and Australian institutions (e.g., Macquarie University, University of Pecs), emphasizes the collaborative nature of the field. Exploring collaborative efforts could provide insights into the global dynamics of research in this domain.

The analysis of keywords revealed not only core themes but also evolving trends. The color-coded temporal map of keywords effectively captured the shifting interests, suggesting a need for ongoing exploration of emerging areas such as "pre-primary education" and "technology."

This study lays the groundwork for a deeper understanding of the early language teaching scenario, prompting further investigations into the temporal dynamics of citations, regional influences, and collaborative efforts. The identified trends and influential figures can guide future research endeavours and international collaborations in this dynamic field. Researchers and policymakers can leverage the identified trends and influential works to inform future studies and educational practices in the field of early language teaching.

The study suggests that time-normalized indicators could be valuable for future studies, especially when compared with other metrics like altmetric indicators. The potential use of different databases could further explore the impact and influence of specific topics in early language teaching research. The study's implications, both theoretically and practically, make it a valuable resource for the scientific community. The insights provided, from identifying trends to highlighting influential figures and areas, offer a foundation for future research in early language teaching.

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7. Appendices

Appendix 1. Top 100 publications Average per Year table

A/Y Rank	Referencias	A/Y	No. Citations
1	Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18months. *Developmental Science*, *16*(2), 234–248. https://doi.org/10.1111/desc.12019	58,55	644
2	Kuhl, P. K. (2010). Brain Mechanisms in Early Language Acquisition. *Neuron*, *67*(5), 713–727. https://doi.org/10.1016/j.neuron.2010.08.038	26,43	370
3	Hammer, C. S., Hoff, E., Uchikoshi, Y., Gillanders, C., Castro, D. C., & Sandilos, L. E. (2014). The language and literacy development of young dual language learners: A critical review. *Early Childhood Research Quarterly*, *29*(4), 715–733. https://doi.org/10.1016/j.ecresq.2014.05.008	18,30	183
4	Sullivan, A., & Bers, M. U. (2016). Robotics in the early childhood classroom: Learning outcomes from an 8-week robotics curriculum in pre-kindergarten through second grade. *International Journal of Technology and Design Education*, *26*(1), 3–20. https://doi.org/10.1007/s10798-015-9304-5	16,88	135
5	Piller, I., & Gerber, L. (2021). Family language policy between the bilingual advantage and the monolingual mindset. *International Journal of Bilingual Education and Bilingualism*, *24*(5), 622–635. https://doi.org/10.1080/13670050.2018.1503227	15,00	45
6	Kayi-Aydar, H. (2015). Teacher agency, positioning, and English language learners: Voices of pre-service classroom teachers. *Teaching and Teacher Education*, *45*, 94–103. https://doi.org/10.1016/j.tate.2014.09.009	14,89	134
7	Lamb, M. (2017). The motivational dimension of language teaching. *Language Teaching*, *50*(3), 301–346. https://doi.org/10.1017/S0261444817000088	13,71	96
8	Birdsong, D. (2018). Plasticity, Variability and Age in Second Language Acquisition and Bilingualism. *Frontiers in Psychology*, *9*, 81. https://doi.org/10.3389/fpsyg.2018.00081	12,33	74
9	Paradis, J., & Jia, R. (2017). Bilingual children's long-term outcomes in English as a second language: Language environment factors shape individual differences in catching up with monolinguals. *Developmental Science*, *20*(1), e12433. https://doi.org/10.1111/desc.12433	11,29	158
10	DeKeyser, R., Alfi-Shabtay, I., & Ravd, D. (2010). Cross-linguistic evidence for the nature of age effects in second language acquisition. *Applied Psycholinguistics*, *31*(3), 413–438. https://doi.org/10.1017/S0142716410000056	9,50	133

11	Wang, S., & Vasquez, C. (2012). Web 2.0 and Second Language Learning: What Does the Research Tell Us? *Calico Journal*, *29*(3), 412–430. https://doi.org/10.11139/cj.29.3.412-430	9,42	113
12	Butler, Y. G. (2015). English language education among young learners in East Asia: A review of current research (2004-2014). *Language Teaching*, *48*(3), 303–342. https://doi.org/10.1017/S0261444815000105	8,78	79
13	Begus, K., Gliga, T., & Southgate, V. (2016). Infants' preferences for native speakers are associated with an expectation of information. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(44), 12397–12402. https://doi.org/10.1073/pnas.1603261113	8,63	69
14	Westlund, J. M. K., Jeong, S., Park, H. W., Ronfard, S., Adhikari, A., Harris, P. L., DeSteno, D., & Breazeal, C. L. (2017). Flat vs. Expressive Storytelling: Young Children's Learning and Retention of a Social Robot's Narrative. *Frontiers in Human Neuroscience*, *11*, 295. https://doi.org/10.3389/fnhum.2017.00295	8,14	57
15	Munoz, C. (2014). Contrasting Effects of Starting Age and Input on the Oral Performance of Foreign Language Learners. *Applied Linguistics*, *35*(4), 463–482. https://doi.org/10.1093/applin/amu024	7,80	78
16	Seidl, A., & Cristia, A. (2012). Infants' learning of phonological status. *Frontiers in Psychology*, *3*, 448. https://doi.org/10.3389/fpsyg.2012.00448	7,75	93
17	Paradis, J., & Kirova, A. (2014). English second-language learners in preschool: Profile effects in their English abilities and the role of home language environment. *International Journal of Behavioral Development*, *38*(4), 342–349. https://doi.org/10.1177/0165025414530630	7,00	49
18	Brenders, P., van Hell, J. G., & Dijkstra, T. (2011). Word recognition in child second language learners: Evidence from cognates and false friends. *Journal of Experimental Child Psychology*, *109*(4), 383–396. https://doi.org/10.1016/j.jecp.2011.03.012	5,77	75
19	Granena, G. (2013). Individual Differences in Sequence Learning Ability and Second Language Acquisition in Early Childhood and Adulthood. *Language Learning*, *63*(4), 665–703. https://doi.org/10.1111/lang.12018	5,73	63
20	Theoharis, G., & O'Toole, J. (2011). Leading Inclusive ELL: Social Justice Leadership for English Language Learners. *Educational Administration Quarterly*, *47*(4), 646–688. https://doi.org/10.1177/0013161X11401616	5,69	74
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Appendix 2. Co-occurrences table of keywords

Keywords	Occurrences
Acquisition	19
English	18
Language	18
Bilingualism	14
Children	12
Vocabulary	12
Phonological awareness	9
Teachers	9
Language development	8
Skills	8
Education	7
2nd-language	6
2nd-language acquisition	6
Learners	6
Performance	6
Achievement	5
Attention	5
Bilingual	5
Early childhood	5
Experience	5
Impairment	5
Knowledge	5
Literacy	5
Preschool	5
Proficiency	5
Spanish	5
Speech-perception	5
Technology	5
Working-memory	5
Age	4
Critical period	4
Early foreign language learning	4
Efl	4
English language learners	4
Exposure	4
Individual-differences	4
Infants	4
Instruction	4
Intervention	4

Kindergarten	4
Literacy development	4
Outcomes	4
Predictors	4
Preschool-children	4
Second language learning	4
Short-term-memory	4
Vocabulary acquisition	4
Young learners	4
1st	3
2nd language	3
Awareness	3
Bilingual education	3
Chinese	3
Comprehension	3
Early childhood education	3
Early literacy	3
English as a foreign language	3
Event-related potentials	3
Foreign language teaching	3
Foreign-language	3
French immersion	3
Growth	3
Impact	3
Input	3
L1	3
Maturational constraints	3
Memory	3
Multilingualism	3
Nonword repetition	3
Perception	3
Pre-primary education	3
Programs	3
Reading-comprehension	3
Sensitivity	3
Social-interaction	3
Socioeconomic-status	3
Speech	3
Starting age	3
Word recognition	3
Working memory	3
1st year	2

Age constraints	2
Aptitude	2
Auditory-cortex	2
Biliteracy	2
Brain	2
China	2
Clil	2
Cognitive-development	2
Constraints	2
Cortical response	2
Critical-period	2
Critical-period hypothesis	2
Curriculum	2
Developmental-changes	2
Dual language learners	2
Early identification	2
Elementary-school students	2
Emergent literacy	2
Executive function	2
Expressive vocabulary	2
Foreign language education	2
Foreign language learning	2
Head-start	2
Identity	2
Immersion	2
Infant-directed speech	2
Language proficiency	2
Language-development	2
Learning English	2
Measuring implicit	2
Minority	2
Motivation	2
Multilingual education	2
Music	2
N400	2
Oral language	2
Pedagogy	2
Perspectives	2
Plasticity	2
Pre-school education	2
Pre-service teachers	2
Preschool children	2

Professional-development	2
Read	2
Receptive vocabulary	2
Recognition	2
Risk	2
School readiness	2
Second language	2
Second language acquisition	2
Sensitive periods	2
Songs	2
Spanish-speaking children	2
Stories	2
Students	2
Task	2
Teacher beliefs	2
Teacher education	2
Translanguaging	2
Translation	2
Variability	2
Vocabulary development	2
Vocabulary growth	2
Word learning	2