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SEÇÃO: LITERATURE REVIEW

Executive functions in English second language learning: a systematic mapping review

Funções executivas no aprendizado de inglês como segunda língua: um mapeamento sistemático da literatura

Funciones ejecutivas en el aprendizaje del inglés como segundo idioma: Un mapeo sistemático de la literatura

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Abstract: Recently, neuroscience studies have helped the field of Education to understand how the brain processes information and how teachers can benefit from this knowledge, specially related to Executive Functions (EFs). EFs can be described as the set of skills which allow us to perform the necessary actions to achieve a goal. There are three core EFs: working memory, inhibitory control, and cognitive flexibility. In the field of second language teaching and learning, are these skills integrated into the classroom practice by teachers? If so, how? Does it benefit students' learning somehow? Also, are EFs included in the curriculum of teachers' training programs? Are future teachers being prepared to integrate EFs to develop their students' skills? This study aims to look for clues about these issues in recent literature and to find studies with approaches to ESL that stimulate the EFs in the learning process and how these methods are developed in teachers' training contexts using the systematic mapping study as a method. This study considered articles from 2011 to October 2021, looking for strings related to ESL, such as teacher training and EFs. The search showed results in Scopus, Web of Science, Pub-Med, Science Direct/Elsevier and data from specific SLA journals, such as Cambridge Core, Journal of English as International Language, TESOL International Journal, Linguistics Journal and Asian EFL Journal. The first search resulted in 5803, from which 3 full read after applying the inclusion/exclusion criteria. As the number of articles was very low, the snowballing method was applied, resulting in more 117 articles from which other 3 were analyzed. The six studies indicated that both qualitative and quantitative data are usually used. Also, it is possible to notice that studies relating aspects of neuroscience to the ESL approaches are still in the beginning. The articles' authors mention the need for further studies. Teachers generally are not prepared to include critical thinking in their classroom practices. Studies which developed practices and gathered data show that the students' critical thinking and metacognition improved. Teachers should have developed their own metacognition and critical thinking to enhance their students' skills.

Keywords: executive functions, English as a second language, teacher training

Resumo: Recentemente os estudos de neurociências têm auxiliado a área da Educação a compreender como o cérebro processa a informação e como os professores podem se beneficiar deste conhecimento, especialmente, no que se refere às Funções Executivas (FEs). As FEs podem ser descritas como um conjunto de habilidades que permite executar as ações necessárias para alcançar um objetivo. Há três FEs principais: memória de trabalho, controle inibitório e flexibilidade cognitiva. Na área de ensino e aprendizagem de segunda língua, essas habilidades estão sendo integradas às práticas pedagógicas de sala de aula pelos professores? Se estão, de que forma? Isto beneficia o aprendizado dos alunos de alguma forma? Ainda, as FEs estão incluídas nos currículos de formação



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de professores, cursos de licenciatura? Os futuros professores estão sendo preparados para integrar as FEs no desenvolvimento das competências e habilidades dos seus alunos? Esta investigação tem o objetivo de procurar pistas dessas questões na literatura recente e de encontrar estudos sobre abordagens de ensino de inglês como segunda língua que estimulem as FEs no processo de aprendizagem e como esses métodos são desenvolvidos no contexto dos cursos de licenciatura utilizando o mapeamento de revisão sistemática como método. Considera artigos de 2011 a outubro de 2021, procurando por linhas relacionadas ao ensino de inglês como segunda língua, tais como formação de professores e FEs. A pesquisa mostrou resultados nas bases Scopus, Web of Science, Pub-Med, Science Direct/Elsevier e bases de periódicos específicos de ensino de inglês como segunda língua, tais como Cambridge Core, Journal of English as International Language, TESOL International Journal, Linguistics Journal e Asian EFL Journal. A primeira busca resultou em 5803 estudos dos quais três foram lidos por inteiro depois de aplicar os critérios de inclusão/exclusão. Visto que o número desta busca foi baixo, o método denominado *snowballing* foi utilizado, resultando em mais 117 artigos, dos quais mais três foram completamente analisados. Os seis estudos indicam que abordagens qualitativas e quantitativas são usadas para coleta de dados. No entanto, é possível perceber que estudos que relacionam aspectos de FEs às abordagens de ensino de inglês como segunda língua ainda estão no início. Os próprios autores dos artigos mencionam a necessidade de mais estudos. Em geral, os professores não estão preparados para incluir pensamento crítico às suas práticas de sala de aula. Os estudos que desenvolveram práticas e reuniram dados mostram que a metacognição e o pensamento crítico dos alunos melhorou. Professores precisam desenvolver sua própria metacognição e pensamento crítico de forma que eles possam entender melhor como melhorar essas habilidades em seus alunos.

Palavras-chave: funções executivas, ensino de inglês como segunda língua, formação de professores

Resumen: Recientemente, los estudios de neurociencia han ayudado al área de Educación a comprender cómo el cerebro procesa la información y cómo los docentes pueden beneficiarse de este conocimiento, especialmente en lo que respecta a las Funciones Ejecutivas (FE). Las FE se pueden describir como un conjunto de habilidades que le permiten realizar las acciones necesarias para lograr un objetivo. Hay tres FE principales: memoria de trabajo, control inhibitorio y flexibilidad cognitiva. En el área de enseñanza y aprendizaje de segundas lenguas, ¿están siendo integradas estas habilidades en las prácticas pedagógicas del aula por parte de los docentes? Si es así, ¿de qué manera? ¿Esto beneficia el aprendizaje de los estudiantes de alguna manera? Además, ¿las FE están incluidas en los planes de estudios de formación docente, carreras de grado? ¿Se están preparando los futuros profesores para integrar las FE en el desarrollo de las habilidades y destrezas de sus alumnos? Este estudio tiene como objetivo buscar pistas para estas preguntas en la literatura reciente y encontrar estudios sobre enfoques para la enseñanza del inglés como segundo idioma que estimulen las FE en el proceso de aprendizaje y cómo estos métodos se desarrollan en el contexto de los cursos de pregrado utilizando el mapeo de revisión sistemática como método. Este

estudio considera artículos desde 2011 hasta octubre de 2021, buscando líneas relacionadas con la enseñanza del inglés como segunda lengua, como la formación docente y los EF. La investigación mostró resultados en las bases de datos Scopus, Web of Science, Pub-Med, Science Direct/Elsevier y bases de datos de revistas específicas sobre la enseñanza del inglés como segundo idioma, como Cambridge Core, Journal of English as International Language, TESOL International Journal, Linguistics Journal y Asian EFL Journal. La primera búsqueda resultó en 5803 estudios de los cuales 3 fueron leídos en su totalidad después de aplicar los criterios de inclusión/exclusión. Dado que el número de esta búsqueda fue bajo, se utilizó el método denominado bola de nieve, resultando 117 artículos más, de los cuales 3 más fueron analizados completamente. Los seis estudios indican que se utilizan enfoques cualitativos y cuantitativos para la recopilación de datos. Aún así, es posible notar que los estudios que relacionan aspectos de las FE con enfoques para la enseñanza del inglés como segundo idioma aún están en pañales. Los propios autores de los artículos mencionan la necesidad de más estudios. En general, los docentes no están preparados para incluir el pensamiento crítico en sus prácticas de aula. Los estudios que desarrollaron prácticas y recopilaron datos muestran que la metacognición y el pensamiento crítico de los estudiantes mejoraron. Los docentes deben desarrollar su propia metacognición y pensamiento crítico para que puedan comprender mejor cómo mejorar estas habilidades en sus alumnos.

Palabras clave: funciones ejecutivas, enseñanza del inglés como segunda lengua, formación de profesores

Neuroscience has contributed significantly to understanding how our brain develops, works, and learns: from ways of testing/measuring performance to brain scans. These findings have brought to light important characteristics in many areas, especially Education. In this field, a group of mental processes called Executive Functions (EFs) have helped educators change their views and consequently their practices aiming to facilitate students' learning.

According to Diamond (2014, p. 7), EFs "refer to a family of top-down processes needed when you have to concentrate and pay attention, when "going on automatic" or "relying on instinct or intuition would be ill-advised, insufficient, or impossible". EFs are directly related to the processes happening throughout our daily life as well as in formal and informal learning settings. There is a broad agreement that working memory (WM), inhibitory control and cognitive flexibility are the three core EFs and that reasoning, problem-solving and planning, which are examples of

higher-order EFs, are built from these (Diamond, 2014).

All these functions work inside classrooms and in our everyday life. EFs are necessary to organise our room, make our bed, choose ingredients for our recipes, take turns while talking to our friends, and remember phone numbers. Therefore, their usefulness seems unquestionable, and the more stimulated they are, the more efficient they become, leading to a better way of coping with several different situations. In the context of this study, this systematic mapping study is important to a better understanding of the neuroscience scope related to second language learning. Furthermore, this study seeks to indicate contributions, tendencies and gaps related to neurosciences beliefs and their benefits to second language learning and teaching training.

This article begins with some considerations about neurosciences and its relation to *Base Nacional Comum Curricular* (BNCC)³, the document which regulates education in Brazil from Kindergarten to High School, advances to the systematic review methodology, presenting the quantitative results and the moves to the final considerations on the contributions and gaps in this area.

Background

The *Base Nacional Comum Curricular – BNCC* (Brasil, 2018) is the normative document which regulates education in Brazil. It establishes knowledge and skills each student is expected to develop during the school years, from Primary to Secondary, in public and private. This document lists 10 general competencies and 06 specific ones (English Language). These are excerpts from numbers 2 and 5 (general) and 5 (specific):

2. [...] including investigation, reflection, critical analysis, imagination and creativity to investigate causes, elaborate and test hypotheses, formulate and solve problems and create solutions [...].

5. [...] to communicate, access and disseminate information, produce knowledge, solve problems [...].

5. Use new technologies, with new languages and modes of interaction, to research, select, share, position oneself and produce meanings in literacy practices in the English language in an ethical, critical, and responsible way.

Furthermore, looking into the 6th year skills, these are the verbs listed in BNCC as the minimal achievement expected from the students: interact, collect, recognise, apply, plan, hypothesise, identify, locate, explore, list, organise, produce, build, use, describe, investigate, identify, evaluate, require. It is important to notice that some verbs describe actions of lower-order thinking skills, such as *identify*, whereas *evaluate* is an example of a higher-order thinking skill verb (Armstrong, 2010).

The three core EFs proposed by Diamond (2014) are directly linked to these actions: the better the former, the better the latter. A good development of WM, inhibitory control and cognitive flexibility make it easier for the students to master the mentioned competencies and skills proposed by the BNCC as the essential ones each student is supposed to accomplish during their school years.

In English as a Second Language (ESL) teaching, many approaches aim to develop these skills. A reading comprehension lesson, for example, may have pre-reading activities which encourage students to guess what the text is about, followed by skimming and/or scanning steps to help students understand the whole context as well as specific information. They are essential to get a deep understanding of the text. Working memory plays a relevant role in this process, not only by helping the student to establish meaning but also by making connections to other texts; inhibitory control helps students to focus on the information given by the author; and cognitive flexibility benefits students in reading between the lines to make assumptions based on evidence from the text.

The process of learning any other language

³ Base Nacional Comum Curricular is the main document that rules Basic Education in Brazil (<http://basenacionalcomum.mec.gov.br>).

different from the first language is dealt with by Second language learning (SLL) theories as defined by Ellis (2000). Thus, Ellis claims that there are various ways to identify how learners acquire their second language. In his opinion, "A better approach might be to find out what learners actually do, as opposed to what they think they do, when they try to learn an L2" (Ellis, 2000, p. 4).

"How the human brain processes and learns new information" (Mitchell & Myles, 2004, p. 95) are basically studied by cognitive approaches. To psychologists, learning results from our brain turning controlled practices into automatic ones. These processes involve our short-term memory using new words and chunks and storing them in our long-term memory. Repetition is the key to this achievement, so they will be available when needed. Once our brain automatizes simple forms, it can move on to more complex structures. This movement goes on continuously, always from controlled to automatic processes. However, the repetition mentioned above is not the act of memorising lists, such as irregular verbs list. The processes of repetition, elaboration, and consolidation (Cosenza & Guerra, 2011, p. 62) are the ones that help humans to develop this automaticity. Repetition is understood as reusing information in different ways, through different perspectives, elaborating new pieces of information to the knowledge already built. The more connections established, the easier to access the information automatically. According to Cosenza and Guerra (2011, p. 63), several sensorial ways to stimulate the brain are important, "Besides verbal processing, it is good to use auditive, tactile, visual or even smell and taste. Along with a text, it is good to use figures, video images, songs, practices which involve the body"⁴.

The sociocultural and the sociolinguist perspectives (Mitchell & Myles, 2004) claim that input is not just a source of interaction, but it has a much more key role, for some researchers, even being the ultimate nature of language.

Sociocultural researchers claim that the ultimate reason for language development is social, that is to interact with people and the environment. Most of these theories have been based on Vygotsky's work (Mitchell & Myles, 2004), applying his arguments to the process of learning a second language. Interaction is closely related to emotions, and they have, without a doubt, a considerable influence on the learning process. Feelings can facilitate our brain connections, whereas stress might have the opposite effect. Emotions are inevitable, but we can learn to control them and enhance our feelings' self-knowledge (Cosenza & Guerra, 2011). Teachers who consider emotions during the learning process prepare a safe classroom environment in which stress is left outside, students feel comfortable engaging in the lesson, and positive emotions are cultivated.

The sociolinguistic approach (Mitchell & Myles, 2004) considers language in use. Some researchers deal with language variability, for example, the fact that people speak according to the social context they are in. Cosenza and Guerra (2011) state that the EFs should ensure respect for the social rules according to the ethical standard of each person's cultural group. A relevant concept in this approach is the communities of practice, which is related to the identities of each person and the cultural society and community (Mitchell & Myles, 2004).

According to Moran (2022), a well-known researcher of technology in education, a good course excites, surprises, makes students think, provides active engagement and brings meaningful contributions, putting students in contact with other people, experiences and interesting ideas. These actions are products of our brain activity, since "Our sensations and perceptions, kinaesthetic action, emotions, thoughts, ideas, decisions, that is, our mental functions are associated to the working brain" (Cosenza & Guerra, 2011, p. 141). Therefore, stimulating EFs using strategies to enhance them is of paramount importance in education.

⁴ Authors' version.

Moran (2015, p. 29) states three important dimensions that should be integrated when an institution wants to innovate: (1) emphasize each student's the project of life, (2) emphasize values and broad competencies (knowledge and socioemotional) and (3) balance between personal and group learning. Moran (2015, p. 42) continues defining the role of teachers as (a) curators, the one who chooses what information is relevant for the students and helps them to find meaning through the proposed activities, as well as the one who takes care, supports, stimulates, values, guides and inspires. And there is a second role, (b) orientators, the ones who show paths, ask questions and provide materials to individuals and groups. These roles will only be successful if the students have the necessary competencies to work accordingly, which means that those skills mentioned by BNCC must be developed. Therefore, stimulating EFs is crucial for an effective learning process.

Nowadays, there are many apps and platforms to help teachers in the task of providing various ways to deal with information. For example, Padlet, a collaborative web platform in which users can upload, organize, and share content, accepts a variety of media: videos, podcasts, images, gifs, and texts, which provides opportunities for the students to deal with information through different senses. Digital Information and Communication Technologies (DICT) allows to create different pedagogical practices integrating technology into education, exploring the importance of a hybrid context: face-to-face blended with asynchronous tasks.

The technological view of education is reinforced by Valente (2015, p. 13) when defining Hybrid Education as a "pedagogical approach that combines face-to-face and online activities mediated by the Digital Information and Communication Technologies". Valente affirms that the education focus has to change from teachers to the students: nowadays they take responsibility for their learning process, participating more, solving problems, developing projects, and designing opportunities to build

their knowledge. Some benefits of this approach are (a) students dealing with content before classes allow them to spend the necessary time individually, which can be different for each student, (b) students are encouraged to become more autonomous as they perform tasks or self-assessments online; (c) the self-assessment results indicate to the teachers how well students understood the content; (d) if students dealt with the topic previously, time in class can be used for discussions, analysis, and re-evaluating their findings, building new knowledge; and (e) interaction and collaboration in the classroom, which are fundamental in this approach and not motivated in traditional classroom settings, can be implemented (Valente, 2015).

Consequently, Hybrid Education does not mean reducing classes into a simple mixing of face-to-face and online settings but proposes several types of blending: challenges, individual and group work, projects, games, personalized learning, different methodologies, integrating knowledge from different areas (interdisciplinarity), according to Moran (2015). This author states that learning is a process that best happens when there is a combination of individual and collective work. The former relates to learning trails and the latter to multiple ways of collaboration: the constant movement between these different forms of communication (oneself reflection and group sharing) creates a permanent elaboration environment in which social interactions occur. This balance provides time for students to deepen, reflect, rethink, produce and summarise in the current dynamic world with multiple languages, screens, and cultures.

Adaptable platforms and apps have been developed and they can be used as a tool to check how students learn, what competencies they have already acquired, and which ones are still in progress. This means that technology provides ways to plan different activities, individually paced, which can be tracked, and accompanied by teachers. Integrating Digital Information and Communication Technologies means innovating lesson planning, pedagogical

practices and putting students in the main role of a lesson. If students are expected to become proactive, teachers should propose tasks that completely involve students. If they are expected to become creative, they should be exposed to creative experiences.

Moran (2015, p. 34) presents his view about how Hybrid Education:

Challenges and activities can be measured, planned, monitored, and evaluated with the support of technologies. Well-planned challenges contribute to mobilizing the desired intellectual, emotional, personal, and communicational skills. They require researching, evaluating situations, different points of view, making choices, taking some risks, learning through discovery, moving from the simple to the complex.

BNCC establishes the exact above competencies as learning goals: research, evaluation, and taking a decision. Therefore, it is possible to consider that DICTs contribute to the stimulation of the EFs by promoting tasks involving working memory, inhibitory control, and cognitive flexibility. However, this is an emerging study area so further studies that consider the digital culture and its implication for education are important and necessary. This innovative intersection of ESL, Efs, and DICT will probably cause a great impact on students and their learning.

Finally, DICT allows teachers and students to respect their individualities without feeling worried about timing since each one advances at their own pace, not causing delays to their colleagues. With the advance in technology

and the ease of access, researchers have been looking for options to enhance language learning. Furthermore, DICT are considered an alternative to boasting active engagement of the pupils in the learning process as well as allowing teachers to vary the ways students deal with content and follow their students learning process by tracking their reflections, answers, and analysis.

Research method

This paper aims to find studies with approaches to ESL that stimulate the Efs in the learning process and if/how these methods are developed in teachers' training contexts. In other words, what are the contributions of the Efs to the second language learning area? If there are studies relating Efs to ESL, are they also being considered in teacher training programs? If yes, how are they dealt with?

Based on Petersen, Feldt, Mujtaba and Mattsson (2008) and Petersen, Vakkalanka and Kuzniarz (2015), the method proposes a mapping of primary studies. The following steps were followed: (1) the research questions were established, (2) the search process was defined, (3) the filtering criteria were decided, and (5) the analysis and classification of the results were performed.

Eligibility criteria

Table 1 shows the criteria applied to consider a work eligible for this systematic mapping study.

Table 1 – Inclusion / Exclusion criteria

Inclusion Criteria	Exclusion Criteria
IC1 articles from 2011 to 2021	EC1 duplicated articles
IC2 in English	EC2 EFs related to a specific competence (e.g. reading, listening)
IC3 population from school do High school	EC3 population
IC4 teacher training courses (university)	EC4 children's atypical development
	EC5 systematic review

Source: The authors.

Related to the EC1, duplicated articles, the process used was to compare the titles, authors, year and abstract. If all of them were the same, the article was discarded, otherwise it was let inside the scope of the study. The chosen duplicated articles were from the list of databases mentioned in the search process. Related to EC2, this study aims to search for articles dealing with the three core Efs, according to Diamond (2014), working memory, inhibitory control and cognitive flexibility and not only a part of them or of others Efs.

Definition of the string search

The string used to proceed with the search was: *(executive functions)* AND *(second language learning OR foreign language OR additional*

language) AND *(school OR college OR university OR Higher Education) AND (teacher training OR pre-service teachers) NOT (bilingual OR early childhood OR kindergarten).*

Research questions

The questions were divided into three groups: general questions (GQ), focal questions (FQ) and evidence questions (EQ). This organisation was used to provide a view from different perspectives: the GQs aim to encompass a broader scope, whereas the FQs focus on specific information, and the Eqs aim to map the studies. Hence, it is possible to gather a range of information from general to specific views. Table 2 shows the questions of each group.

Table 2 – Research questions

Type	Questions
GQ1	What methods are being applied to English as a Second Language studies?
GQ2	Which strategies are being used to stimulate EFs necessary to the linguistic competencies development?
FQ1	How did the studies analyse the influence of the EFs in the learning process of ESL?
FQ2	Which articles are related to EFs in the context of ESL?
FQ3	Which articles related EFs to teacher training programs?
EQ1	Where are the main studies located?
EQ2	What are the tendencies of the studies?

Source: The authors.

Search process

The search for articles on the topic was done through Rayyan⁵, a tool which enables import into it works from several databases and verify which studies relating Efs, ESL and teacher training have been conducted within the last decade,

from 2011 to 2021.

The databases included at Rayyan were: (1) Scopus⁶, (2) Web of Science⁷, (3) Pub-Med⁸, (4) Science Direct/Elsevier⁹ and data from specific SLA journals, such as (5) Cambridge Core¹⁰, (6) Journal of English as International Language¹¹,

⁵ Rayyan (<https://www.rayyan.ai> retrieved October 22, 2021).

⁶ Scopus (<https://www.scopus.com> retrieved October 22, 2021).

⁷ Web of Science (<https://www-webofscience.ez310.periodicos.capes.gov.br/wos/woscc/basic-search> retrieved October 22, 2021).

⁸ PubMed (<https://www.ncbi.nlm.nih.gov/pubmed> retrieved October 22, 2021).

⁹ Science Direct/Elsevier (<https://www.sciencedirect.com> retrieved October 22, 2021).

¹⁰ Cambridge Core (<https://www.cambridge.org/core> retrieved October 23, 2021).

¹¹ Journal of English as International Language (<https://www.eilj.com> retrieved October 23, 2021).

(7) TESOL International Journal¹², (8) Linguistics Journal¹³ and (9) Asian EFL Journal¹⁴.

The initial selection was made by reading the title, the abstract and the keywords. Based on these, the articles were included or excluded according to the criteria mentioned in the eligibility criteria. The included articles were then fully

downloaded and read thoroughly. Throughout study, all authors participated actively in the process of decision-making and analysis of the papers. The string search resulted in 5803 articles. Figure 1 shows the result after the inclusion/exclusion criteria were applied.

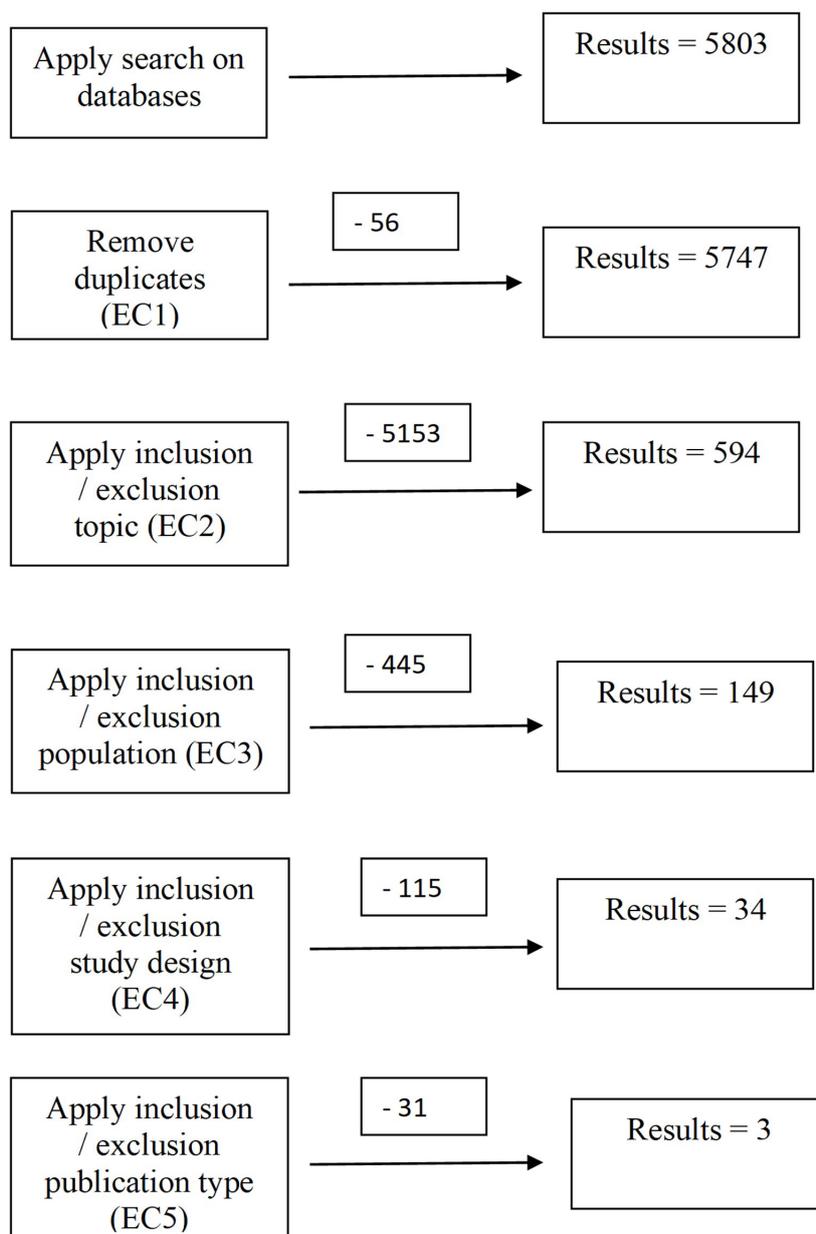


Figure 1. Number of included articles during the searching selection process.

Source: The authors.

¹² TESOL International Journal (<https://www.tesol-international-journal.com> retrieved October 23, 2021).

¹³ Linguistics Journal (<https://www.elejournals.com/linguistics-journal> retrieved October 23, 2021).

¹⁴ Asian EFL Journal (<https://www.asian-efl-journal.com> retrieved October 23, 2021).

As the number of studies was not many, the snowballing approach (Wohlin, 2014) was applied to avoid missing any other studies during the first database search. It consisted in looking for all the references of the three selected articles above

and putting them into a second search through Rayyan. To this selection, the same inclusion and exclusion criteria were applied (Table 1). Figure 2 shows the result of the snowballing method.

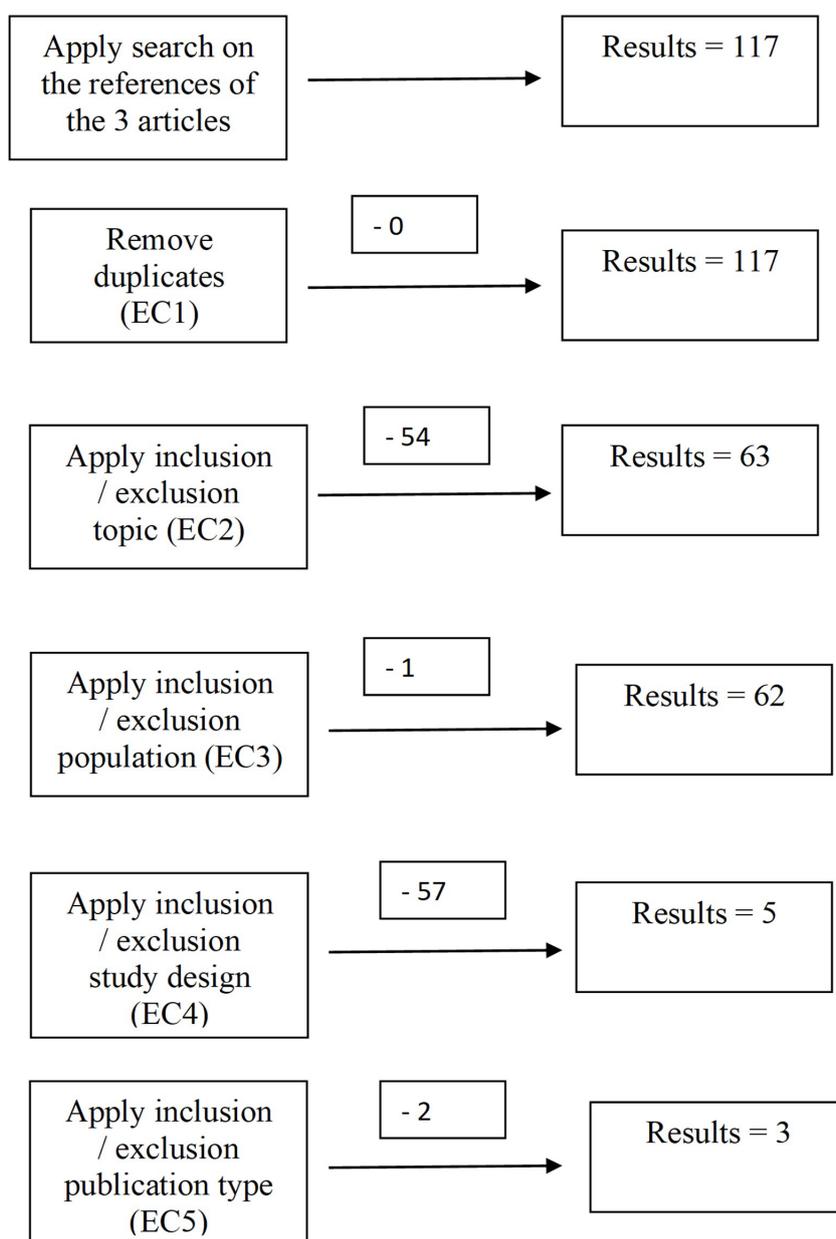


Figure 2. Number of included articles during the snowballing selection process.

Source: The authors.

At the end of the two processes, there were six studies related to the topic. Table 3 below shows detailed information about the final articles.

Articles 1 to 3 were the result of the search on databases, and 4 to 6 were from the snowballing process.

Table 3 – Final result

No	Authors / Title	Database	Journal	H-Index
A1	Phil Hiver, Zack Whiteside, Ana C. Sánchez Solarte & Claudia J. Kim. Language teacher metacognition: beyond the mirror	Scopus	Innovation and Language Learning and Teaching – United Kingdom	17
A2	Anar Popandopulo, Natalia Fominykh, Ainash Kudysheva. Do educators need metacognitive skills in today's educational environment?	Scopus	Thinking Skills and Creativity - Netherlands	40
A3	Hatice Kübra Bag, Esim Gürsoy. The Effect of Critical Thinking Embedded English Course Design to the Improvement of Critical Thinking Skills of Secondary School Learners	Scopus	Thinking Skills and Creativity - Netherlands	40
A4	Weijun Liang, Dennis Fung. Fostering critical thinking in English-as-a-second-language classrooms: Challenges and opportunities	Science Direct / Elsevier	Thinking Skills and Creativity - Netherlands	40
A5	Elcin Petek, Hasan Bedir. An adaptable teacher education framework for critical thinking in language teaching	Science Direct / Elsevier	Thinking Skills and Creativity - Netherlands	40
A6	Li Li. Integrating thinking skills in foreign language learning: What can we learn from teachers' perspectives?	Science Direct / Elsevier	Thinking Skills and Creativity - Netherlands	40

Source: The authors.

Results

In this part, the questions raised by the present study will be answered considering the six articles which were analysed one by one. The articles will be referred as A1, A2, A3 and so on, following the order presented in Table 3.

GQ1 - What methods are being applied to English as a Second Language studies?

Most articles collected data through questionnaires from a bigger group followed by interviews with fewer participants. Lesson planning, class observation and video recording were also used to gather information. Table 4 shows specific information about each study.

Table 4 – Studies' methods

	Data sources	Data analysis
A1	concepts / reflection	other authors' work
A2	Beginning: diagnostic End: questionnaire of Assessing Metacognitive Awareness	descriptive statistics
A3	Pre- and post-measures of Critical Thinking scales	quantitative and qualitative
A4	Pre and post-tests of CT Audio recordings Classroom observation Students' written work Semi-structured interviews (teachers)	quantitative and qualitative
A5	Semi-structured interviews Audio recording Submission of lesson plan	qualitative
A6	Self-report Written questionnaire	quantitative and qualitative

Source: The authors.

It is possible to state that most authors have considered qualitative and quantitative data to proceed with their analysis. Half of them have performed pre and post-evaluation. For data sources, A1 to A4 used diagnosis and pre and post ways of measure (tests or scales).

GQ2 - Which strategies are being used to stimulate EFs necessary for linguistic competencies development?

All articles address issues related to developing critical thinking in language teaching. A1 mentions the importance of this skill. Though it does not bring any specific strategy, it proposes the notion of teacher metacognition so that teachers' reflection becomes more conscious than at the beginning, and the reflective practice turns into better actions. A2 performs a survey about metacognitive skills with teachers who are already working in schools. A3, A4, A5, and A6 address strategies that involve students in the process

of reflection, comparison and argumentation. For example, the Think-Pair-Share technique was used in A5, which demands each student to think about a topic alone, then they are put into pairs and compare their answers/points of view and decide what they are going to share with the whole group.

FQ1 - How did the studies analyse the influence of the EFs in the learning process of ESL?

A1 mentions that metacognition is dependent on executive functions and that they help people to reach their goals, which influences the way students deal with learning and developing their skills. The other articles have data collected showing differences between previous and later knowledge. Awareness (consciously creating activities that demand more student reflection) is mentioned in all articles through the qualitative data, whereas A3, A4 and A6 show the students

changing, getting higher scores after the lessons on critical thinking.

FQ2 - Which articles are related to EFs in the context of ESL?

As critical thinking and metacognition are considered part of the EFs, all articles deal with EFs related to students (A1, A3, A4, A5, A6) or teachers (A2). Every article details the importance of developing students' critical thinking and metacognition as they collected evidence of improvement in the linguistic competencies of the students. They also stress that further studies are

necessary. None of the articles deals with working memory, inhibitory control, or cognitive flexibility.

FQ3 - Which articles related EFs to teacher training programs?

A2 was developed with first-year students for the Educational faculty, which means participants might not become English language teachers. A5 involved pre-service teachers. Participants in A6 were graduated teachers already working in schools, ranging from 1 to 30 years of experience. Table 5 shows more information regarding population and duration.

Table 5 – Population & duration

	Teachers	Students	Duration
A1	-	-	-
A2	-	160 1 st year university students	1 academic month
A3	-	7th grade students	Not mentioned
A4	5 English teachers	125 Primary Five	6 weeks
A5	-	8 senior pre-service English teachers	18 weeks
A6	473	-	1 month

Source: The authors.

There are two studies directly related to teacher training, A2 and A5, whereas A4 and A6 involve teachers who are already working. A1 also mentions the importance of developing teachers' metacognition, so it is possible to assume that it involves teacher training. The duration of the studies is mostly related to one month. The longest study lasted about four months and two weeks. It seems that shorter periods are more

manageable for the researchers and participants.

EQ1 - Where are the main studies located?

Most of the studies are from Europe and Asia. Two studies were developed in Turkey (A3, A5), two in China (A4, A6), one in Kazakhstan (A2), and one in the US (A1).

Figures 3 and 4 illustrate the location and year of publication.

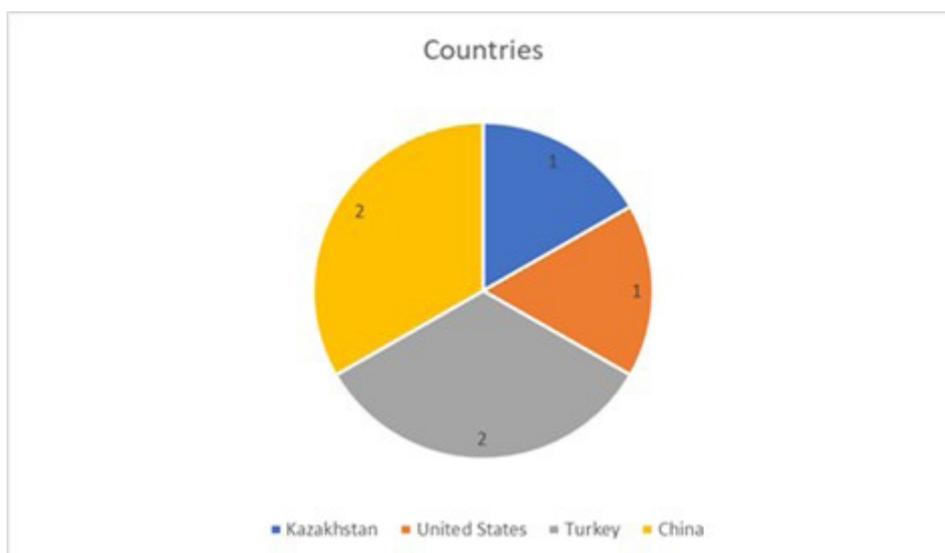


Figure 3. Location.
Source: The authors.

The figures show that most studies are being performed in Europe and Asia. Furthermore, all of them were published in the last five years: in 2016, 2018, 2019 and 2020; one article was published in each year and in 2021, two articles. One reason might be due to the recent relevance of neurosciences in the educational context.

EQ2 - What are the tendencies of the studies?

The studies bring up a shift in the teachers' practices, from the old transmission of knowledge to creating opportunities to interact, explore classroom events, and set up a different learning environment. A5 also adds the curriculum as a hindrance since teachers must ensure it will be accomplished though it might only be related to linguistic knowledge. The articles also mention a lack of studies in the area and suggest further research.

Discussions

The articles raised some important and interesting issues about EFs and teacher training. Firstly, teachers are not prepared to include Critical Thinking in the language teaching environment. Two examples to support this: A5 states that *"the teachers are not well equipped*

with the awareness to convey these competencies into the learning environment". A6 mentions that *"There is a strong case for arguing for immediate teacher training to develop both content and pedagogical knowledge of teaching thinking skills"*, *"Closely related to this is the lack of training and professional development opportunities"*, and *"Clearly, if teachers lack knowledge (both content and pedagogical), innovation can only stay at the policy level"*. Therefore, it seems plausible to be concerned about integrating EFs into the context of ESL teacher training courses.

Secondly, as teachers are supposed to help students develop their metacognitive skills, it is a must that teachers have developed their own. A1 mentions that *"We would suggest that teacher education – for both pre-service and practicing teachers – can direct the process of development and help practitioners strengthen their metacognitive capacities"*. How should teachers stimulate their students' EFs as established by the BNCC if they themselves have gaps related to working memory, inhibitory control and cognitive flexibility? This might be a huge challenge.

Thirdly, language teaching should go beyond linguistic aspects, language proficiency and exams. Language teaching should contribute to the whole of the students' lives. This excerpt from A2 *"The role of metacognitive skills is especially*

important for learners from elementary school and throughout life" corroborates with a broaden view, extending classroom practices to social and work environments. Therefore, not only does English language teaching contribute to the students' performance in educational contexts but also to their entire life.

Fourthly, A3, from 2021, states that "*literature for the secondary schools is sparse*" which supports the low number of articles found in the database searches. This might be due to the lack of knowledge about EFs and their contribution to language teaching and learning, indicating opportunities to explore the subject.

Relating these issues to the background, it is significant to apply this knowledge when thinking and planning classroom activities. Developing teachers' awareness of how memorisation, which would instead be called recycling language, and interaction should happen in different contexts in various ways. In this context, technology plays an essential role. The verbs in BNCC, such as interact, collect, plan, explore, produce, investigate, organise can all be developed by applying Information and Communication Technologies (ICTs). The management of ICTs to solve tasks help to stimulate the development of EFs as long as the teachers can benefit from it. As Ellis (2000) stated, what learners actually do might be the key, so the digital platforms allow gathering a significant amount of information about our students, their ideas and their production.

When considering the students' role as the centre of the process as defined by methodologies such as the flipped classroom, it seems that teachers are not prepared yet to let the leading role to the students, even in part of the class. The analysed studies still have more teacher talking time and decisions than the students' opportunity for those. Creativity, collaboration, and problem-solving are desired skills for the 21st century. How can students develop them if teachers are still the centre of the learning process?

In summarising, teacher training programs must find ways to integrate EFs into the classroom practice so that pre-service teachers will have

their competencies developed. This gap must be addressed in university to help future teachers to comprehend how to implement strategies into their practice once they work at schools. The students' leading role could not be noticed in the articles. As education nowadays embraces the students' active participation, the analysed articles did not contribute to this search. Lastly, necessary competencies for the linguistic development such as to collect, recognise, apply, plan, hypothesise, identify, locate, explore, list, organise, produce, build, use, describe, investigate, identify, evaluate, require, and organise were not pointed out in the articles.

Final considerations

This study aimed to shed light on the research dealing with EFs and the ESL context. The number of studies was low, showing there is still breadth to explore this area. Furthermore, the overview displayed a lack of teacher training and teachers' continuous development, supporting these professionals by promoting a better understanding of the concepts related to EFs and how to integrate them into pedagogical practices in the classroom.

The data collected in the articles related to metacognition and critical thinking and their implication in class indicate benefits for students and teachers. Therefore, it is possible to suggest that the three core EFs in education, working memory, inhibitory control, and cognitive flexibility, should be taken into consideration in further studies, especially in teacher training background.

The process defined for the execution of this systematic mapping has limitations that can affect the scope of the results, such as i) the chosen databases; ii) the definition of keywords and search string, and iii) the inclusion and exclusion criteria. However, the decisions made during planning and execution sought to mitigate them.

References

Armstrong, P. (2010). *Bloom's Taxonomy*. Vanderbilt University Center for Teaching. Retrieved October 29,

2021, from <https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy>

Bag, H. K., & Gürsoy, E. (2021). The Effect of Critical Thinking Embedded English Course Design to the Improvement of Critical Thinking Skills of Secondary School Learners. *Thinking Skills and Creativity*, 41(100910), 1-13. <https://doi.org/10.1016/j.tsc.2021.100910>

Brasil. Ministério da Educação. (2018). *Base Nacional Comum Curricular (BNCC). Educação é a Base*. MEC/ CONSED/UNDIME. Retrieved October 20, 2021, from http://basenacionalcomum.mec.gov.br/images/BNCC_publicacao.pdf

Cosenza, R. M., & Guerra, L. B. (2011). *Neurociência e educação: como o cérebro aprende*. Artmed.

Diamond, A. (2014). Understanding executive functions: what helps or hinders them and how executive functions and language development mutually support one another. *Perspectives on Language and Literacy*, 40(2), 7-11. <http://digitaleditions.sheridan.com/publication/index.php?m=13959&i=210099&view=contentsBrowser&ver=html5>

Ellis, R. (2000). *Second Language Acquisition*. OUP.

Hiver, P., Whiteside, Z., Sánchez Solarte, A. C., & Kim, C. J. (2021). Language teacher metacognition: beyond the mirror. *Innovation in Language Learning and Teaching*, 15(1), 52-65. <https://doi.org/10.1080/17501229.2019.1675666>

Li, L. (2016). Integrating thinking skills in foreign language learning: what can we learn from teachers' perspectives? *Thinking Skills and Creativity*, 22, 273-88. <https://doi.org/10.1016/j.tsc.2016.09.008>

Liang, W. & Fung, D. (2021). Fostering critical thinking in English-as-a-second-language classrooms: Challenges and opportunities. *Thinking Skills and Creativity*, 39(100769), 1-12. <https://doi.org/10.1016/j.tsc.2020.100769>

Mitchell, R., & Myles, F. (2004). *Second Language Learning Theories*. Hodder Arnold.

Moran, J. M. (2002). O que é um bom curso a distância? *Boletim do Programa Salto para o Futuro da TV Escola sobre educação a distância*. TVE Brasil. Retrieved October 29, 2021, from <http://www.tvebrasil.com.br/salto/boletins2002/ead/eadtxt1c.htm>

Moran, J. M. (2015). Educação híbrida: um conceito-chave para a educação, hoje. In L. Bacich (Org.), *Ensino híbrido: personalização e tecnologia na educação* (pp. 27-45). Penso.

Petek, E., & Bedir, H. (2018). An adaptable teacher education framework for critical thinking in language teaching. *Thinking Skills and Creativity*, 28, 56-72. <https://doi.org/10.1016/j.tsc.2018.02.008>

Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008). *Systematic Mapping Studies in Software Engineering* [Paper presentation]. The 12th International Conference on Evaluation and Assessment in Software Engineering, EASE '12, ACM: New York, NY, USA.

Petersen, K., Vakkalanka, S., & Kuzniarz, L. (2015). Guidelines for conducting systematic mapping studies in software engineering: An update. *Information and Software Technology*, 64, 1-18. <https://doi.org/10.1016/j.infsof.2015.03.007>

Popandopulo, A., Fominykh, N., & Kudysheva, A. (2021). Do educators need metacognitive skills in today's educational environment? *Thinking Skills and Creativity*, 41(100878), 1-12. <https://doi.org/10.1016/j.tsc.2021.100878>

Valente, J. A. (2015). O ensino híbrido veio para ficar. In L. Bacich (Org.), *Ensino híbrido: personalização e tecnologia na educação* (pp. 13-17). Penso.

Wohlin, C. (2014). *Guidelines for snowballing in systematic literature studies and a replication in software engineering* [Paper presentation]. The 18th International conference on evaluation and assessment in software engineering, 1-10. EASE '14, ACM: New York, NY, USA.

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