

A Decade of EFL Self-Efficacy Research: Empirical Status and Future Directions

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Abstract

With the growing importance of English globally, EFL (English as a Foreign Language) contexts continue to strive to enhance learners' English language learning outcomes. The last decade has witnessed a growing recognition of self-efficacy as a crucial psychological mechanism in learning pursuits. This paper presents a review aiming to paint a picture of a decade of EFL self-efficacy research. The aim of this review is threefold. First, it provides an overall explanation of self-efficacy theory and its potential as one of the strongest determinants of human behavior. Then, it aims to review and thematically synthesize the growing empirical research on EFL self-efficacy in the last decade. Finally, the review pulls the research findings together, providing the foundation for implications for policymakers and future research directions.

Keywords: self-efficacy, learners, English, language learning, EFL

1. Self-Efficacy: An Introduction

During the second half of the 20th century, theories pertaining to learning and human functioning advanced immeasurably, expanding the boundaries of knowledge on human functioning. The publication of Bandura's (1977) *Self-efficacy: Towards a Unifying Theory of Behavioral Change*, in which self-efficacy was first proposed as the missing key to the social cognitive theory and subsequently became a core component of it, was one of these significant achievements (Bandura, 1986). This theory explains human functioning by bringing to light the specific contributions of cognitive, affective, biological, environmental, and behavioral elements. Self-efficacy was identified as a vital element of human agency in the theory, which, along with other personal, contextual, and behavioral elements, influences human functioning. The influence of these beliefs on human behavior has been investigated in clinical psychology (Soysa & Wilcomb, 2015), careers (Yu et al., 2015), sport (McCaffrey et al., 2014), health (Harrington et al., 2017), and education (Arslan, 2012; Mann et al., 2015; Tavakoli & Koosha, 2016).

Self-efficacy is a concept derived from psychology, and it relates to "beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (Bandura, 1997, p. 3). The criticality of efficacy beliefs stems from the fact that one's sense of efficacy has a direct impact on behavior. They influence the thinking, emotions, and actions of the individual. They determine what people pursue, how much work they exert, and their tenacity in the face of obstacles. They also determine whether people's thought patterns are positive or negative, as well as the level of despair or anxiety they may experience when confronted with a challenging situation. The importance of these beliefs on behavior resides in the fact that people will seek to act in a specific manner if they believe their actions will result in valued consequences; conversely, a person will not attempt an action if s/he believes the outcomes are unattainable. These beliefs are nurtured by four main sources: mastery experience, verbal persuasion, vicarious experience, and psychological states. (Bandura, 1997; 1989).

However, self-efficacy should not be confused with other self-concepts, such as self-concept or self-esteem. Self-concept refers to the perceptions that individuals have of themselves based on their own experiences and the perspectives of other individuals whose opinions are of significant value to the individual. Self-esteem, on the other hand, refers to an individual's estimation of self-worth. Neither self-concept nor self-esteem are believed to

be predictive of the individual's behavior, in contrast to self-efficacy beliefs, which are thought to influence the individual's behavior and so predict future performance (Bandura, 1997).

The following subsections provide an overview of the literature on self-efficacy beliefs in EFL contexts during the past decade. Research on self-efficacy as a critical psychological mechanism has already been conducted since the 1970s, but only recently has attention been paid to efficacy beliefs in language learning. The last decade witnessed a drastic increase in research on self-efficacy, and this review attempts to answer the question of what researchers know about learners' self-efficacy in relation to English as a foreign language. Aiming for quality, the review search has been predicated on four well-established databases in education: Education Research Complete (ERC), the Education Resources Information Center (ERIC), APA PsychINFO, and the British Education Index (BEI). The reviewed studies are organized thematically and conclude with implications for future policy and research. An overview of the studies that have investigated self-efficacy beliefs in language learning reveals that researchers were specifically interested in two lines of studies: one line focuses on investigating the relationship between efficacy beliefs and achievement, or other variables that facilitate or hinder achievement such as strategy use, anxiety, motivation, and goals. The other line, on the other hand, focuses more on experimental research that aims to increase learners' self-efficacy beliefs. The following subsections provide an overview of these two lines of research.

2. Self-efficacy and Factors Associated with Language Learning

2.1 Self-Efficacy and Strategy Use

Reviewing EFL self-efficacy studies revealed a strong interest in self-efficacy and language-learning strategies, and both are believed to positively contribute to language performance (Bandura, 1997; Naseri & Zaferanieh, 2012). Language-learning strategies and self-efficacy studies are primarily focused on exploring relationships. Bonyadi et al. (2012) investigated the relationship between strategy use and learners' EFL efficacy beliefs. Data analysis showed no correlation between the two. Much research shows the opposite, however. Heidari et al. (2012) examined Iranian English learners' vocabulary strategies and self-efficacy. The findings showed a positive association between learners' use of strategies and their self-efficacy. It was also reported that students with higher self-efficacy beliefs used more strategies. Kassem's (2015) study reported a positive link between listening strategy use, self-efficacy, and comprehension. Naseri and Zaferanieh (2012) found a significant positive correlation between reading comprehension and reading self-efficacy beliefs, which correlated with reading strategy use. Ahmadian and Pasand (2017), as well as Mohammed (2022), have also reported the same finding. The studies that reported a correlation between strategy use and self-efficacy were specific and addressed strategies in relation to a specific language skill like reading, listening, or vocabulary, whereas Bonyadi et al. (2012) explored language strategy in general and lacked specificity, which may explain their findings.

The interest in examining the relationship between self-efficacy beliefs and language-learning strategies was expanded with the inclusion of various methods of data analysis. Using structural equation modeling (SEM), Sardegna et al. (2018) examined the correlations between several variables, such as pronunciation strategies and self-efficacy beliefs. The researchers discovered that students with stronger self-efficacy beliefs tended to work harder to improve their pronunciation and choose strategies more actively. In accordance with Bandura's (1997) self-efficacy theory, it was also discovered that self-efficacy beliefs were related to pronunciation learning strategies both directly and indirectly, indicating that self-efficacy not only influenced strategy selection but also led students to work harder and regulate their learning. Khodadad and Kaur (2016) used structural equation modelling to evaluate causal links between a variety of variables, including strategy use, motivation, efficacy beliefs, and English-language achievement. The findings indicated that self-efficacy was a significant and direct predictor of motivation. The final model of the SEM analysis revealed that both motivation and self-efficacy beliefs influenced strategy use, but the influence of self-efficacy was greater; furthermore, self-efficacy had a direct effect on English-language achievement. Self-efficacy was found to be a significant predictor of strategy use, as reported by Bai et al. (2021). Other research has also demonstrated that self-efficacy mediates the relationship between achievement and strategy use (Wu et al., 2013). This line of inquiry was expanded upon by Kim et al. (2015), who categorized their participants into three groups based on their self-efficacy beliefs: high, medium, and low. Learners with high and medium self-efficacy beliefs reported considerably greater usage of strategies than those with low self-efficacy. In conclusion, it was repeatedly found that self-efficacy beliefs and strategy use are connected and both contribute to enhanced language performance. (Kassem, 2015; Khodadad & Kaur, 2016; Sardegna et al., 2018).

Beyond examining correlations, another line of inquiry studied the effect of strategy instruction on learners' efficacy beliefs. Yang and Wang (2015) conducted a correlational, quasi-experimental study to examine the relationship between learners' strategy use and their self-efficacy beliefs, as well as the effect of explicit strategy instruction on learners' strategy use and efficacy beliefs. The participants were working adults who attended college at night. Both the control and experimental groups were instructed on six distinct language learning strategies: compensatory, cognitive, memory, metacognitive, emotive, and social. There was no difference between the two groups in terms of strategy use (except for memory strategies) or self-efficacy following the treatment. In contrast to Yang and Wang (2015), Rahimirad and Zare-ee (2015) selected one language learning strategy (metacognitive) and one language skill, listening, to investigate the influence of strategy teaching on learners' listening self-efficacy beliefs. Prior to treatment, there was no significant difference between the groups in terms of listening performance and listening self-efficacy beliefs. However, after treatment, the experimental group's listening self-efficacy was much greater than that of the control group, demonstrating that instruction of metacognitive strategies had led to a considerable boost in the learners' efficacy beliefs. Bakhtiari (2020) investigated the influence of increasing students' awareness of reading strategies through strategy instruction on their reading achievement and reading self-efficacy. The results demonstrated that the strategy instruction had a significant impact on both self-efficacy and reading comprehension in the experimental group's students compared to those in the control group. In a recent study, Alreshoud and Abdelhalim (2022) found that implementing an intervention that teaches students academic and self-regulation skills and strategies increased learners' self-efficacy beliefs.

In conclusion, across different contexts, including Korea (Sardegna et al., 2018), Iran (Ahmadian & Pasand, 2017), Saudi Arabia (Mohammed, 2022), and Egypt (Kassem, 2015), and with different language skills: pronunciation (Sardegna et al., 2018), vocabulary (Heidari et al., 2012), reading (Ahmadian & Pasand, 2017), and listening (Kassem, 2015), self-efficacy has been reported to be positively correlated with strategy use, and both have been shown to positively affect the language-learning outcome. It has been found that self-efficacy motivates students to persist and use strategies actively and more often. The research on the effects of strategy instruction revealed that it led to an increase in self-efficacy beliefs. The latter point on increasing learners' self-efficacy beliefs will be further elaborated shortly.

2.2 Self-Efficacy and Language-Learning Anxiety

Not only has research on language learning and self-efficacy addressed facilitative variables such as strategy, but it has also investigated affective variables such as anxiety. Similar to studies on strategy, research on self-efficacy beliefs and anxiety has focused extensively on examining the links between the two variables. Doğan (2016), for example, requested that 150 Turkish EFL students complete a self-efficacy scale and an anxiety inventory. Analysis of the data revealed a negative association between anxiety and self-efficacy. Sardegna et al. (2018) reported the same result. Briefly, the aforementioned research confirmed that language anxiety has a negative effect on language-learning performance and is negatively associated with self-efficacy beliefs. On the other side, self-efficacy beliefs are associated with reduced levels of anxiety, greater strategy use, and greater achievement.

In contrast to prior research, which concentrated on correlational investigations, Shirvan et al. (2018) conducted a longitudinal study to investigate the dynamic relationship between self-efficacy and anxiety, as both are not stable and are in constant flux. Since both quantitative and qualitative data were required to track the changes in anxiety and self-efficacy over the course of a semester, a mixed-methods research approach was employed. Participating in the study were 367 EFL Iranian undergraduates; data were gathered four times throughout the semester, and four students were selected for follow-up interviews. Similar to research that examined relationships, a negative link was discovered between self-efficacy beliefs and anxiety. There was also a strong association between the growth patterns of self-efficacy and anxiety; in other words, the greater the gain in self-efficacy, the greater the decrease in anxiety level. The results shed light on the dynamic nature of self-efficacy beliefs and anxiety. In accordance with the self-efficacy theory, the findings highlighted the dynamic nature of self-efficacy as well as its sensitivity to other factors, such as the individuality of the participant, as it was found to vary from one participant to another. Although this was not a causal study, the swings in both self-efficacy beliefs and anxiety, notably the fact that an increase in one is accompanied by a drop in the other, indicate the probability of the effect of one on the other.

All examined studies, including those with correlational and longitudinal designs, indicated a negative relationship between self-efficacy beliefs and anxiety. It can be deduced then that, on a micro level, self-efficacy helps learning since it is related to an increase in strategy use and a decrease in anxiety, the former of which

facilitates learning and the latter of which hinders it. More self-efficacy research has been conducted in additional areas and will be examined next.

2.3 Self-efficacy and Motivation

Self-efficacy has also been studied in relation to motivation, which is an affective factor that is believed to positively influence language learning. Motivation has been classified as extrinsic and intrinsic; the former refers to the drive to learn the language being external, such as to get a job, while the latter refers to the learners' internal desire to learn the language. Numerous studies have acknowledged the significance of self-efficacy and motivation and sought to examine the relationship between the two factors. Sener and Erol (2017), for instance, evaluated EFL learners' motivation and self-efficacy beliefs, and 100 EFL students completed scales. A quantitative analysis revealed that the majority of participants were externally motivated, and a correlation was found between self-efficacy beliefs and motivation. This correlation was also reported by Roshandel et al. (2018).

There has also been interest in shining additional light on the nature of this link. Khodadad and Kaur (2016) employed SEM and discovered that self-efficacy is a strong direct predictor of not only motivation but also strategy use and language achievement. Ma et al. (2018) furthered research on motivation and self-efficacy by examining the two types of motivation previously introduced: intrinsic and extrinsic motivation. The investigation revealed a correlation between motivation and language performance. The association between intrinsic motivation and performance was found to be mediated by self-efficacy but not by extrinsic motivation, which has a negligible effect on EFL performance. The same finding was also reported by Zhang and Guo (2012).

The research that examined both motivation and self-efficacy concluded that motivation is positively correlated with self-efficacy, and some have associated self-efficacy in particular with intrinsic motivation, which is highly desired in education given its association with autonomy and lifelong learning (Wu, 2003).

2.4 Self-efficacy and Self-esteem

Few studies have investigated the relationship between personal variables and self-efficacy, such as self-esteem, which is an individual's feeling of self-worth. Their primary objective was to investigate the associations between self-esteem, efficacy, and language achievement. Asakereh and Yousofi (2018), for example, investigated the links between self-efficacy, reflective thinking, self-esteem, and EFL learners' achievement in Iran and discovered a significant association between self-efficacy and achievement, as well as between self-esteem and achievement. On the other side, reflective thinking was not found to be significantly associated with achievement. Additionally, there was a positive link between self-esteem and self-efficacy. In contrast with that study, Zarei and Zarei (2015) investigated the impact of student English accomplishments on self-efficacy and self-esteem and found no significant connections. Despite these results, it should be highlighted that this study had numerous issues. The writers referred to self-efficacy as a personal trait; however, self-efficacy is not a trait; rather, it is a belief in one's own capacity and is malleable. Specifically, self-efficacy is not a fixed trait in an individual; on the contrary, it can be enhanced or diminished with experience. The findings of the above studies were inconsistent, suggesting that more research may be needed to further investigate and understand the relationship between self-esteem and self-efficacy.

2.5 Self-efficacy and Value

Value is another focus of research that has garnered a growing number of studies in relation to self-efficacy. It means the "perceived importance or usefulness of learning" (Schunk & DiBenedetto, 2020, p. 4). Similar to self-efficacy beliefs, value is believed to influence achievement and has been linked to self-efficacy in numerous studies. Eccles and Wigfield (2020) assumed that both self-efficacy and value are determinants of achievement; Phakiti et al. (2013) reported a strong positive association between self-efficacy and value. Bailey and Rakushin-Lee (2021) reported that self-efficacy fully explains the association between language learning participation and value. Both self-efficacy and value are regarded as significant for EFL learners, and English teachers are encouraged to take learners' value into account and help them develop efficacy beliefs and interest (Zhan, Jiang, Wan, & Guo, 2021; Bai et al., 2021).

2.6 Self-efficacy and Goals

Among the additional variables explored in relation to self-efficacy beliefs are goals. The three groups of goals—mastery goals, performance-approach goals, and performance-avoidance goals—were believed to have an impact on the learning process. These have been described as "mastery goals, where students pursue their competence by developing and improving their ability against self-set standards; performance-approach goals,

where learners are concerned about displaying their ability; and performance-avoidance goals, where students' main concern is hiding their lack of ability" (Zafarmand et al., 2014, p. 113). It is considered that these goal orientations influence learning either positively or negatively; in education, mastery goals are favored whereas performance-avoidance goals are not (Zafarmand et al., 2014).

Few studies have examined the association between distinct goal orientations and self-efficacy beliefs. For example, Zafarmand et al. (2014) investigated self-efficacy beliefs, goal orientations, and metacognitive awareness, as well as their interactions. Analyses of quantitative data revealed that mastery goals were positively associated with self-efficacy and metacognitive awareness, but other kinds of goals were not. Furthermore, self-efficacy had a strong correlation with metacognition. It should be highlighted that the goals to which self-efficacy was shown to be correlated were mastery goals, which are advantageous for learning because they are believed to have a stronger positive impact on learning than the other two types of goals. In the He et al. (2012) study, SEM was used to better understand the relationships and found that self-efficacy determined the type of goals pursued by the participants; high self-efficacy encouraged the adoption of mastery goals; and self-efficacy beliefs were negatively associated with the other two types of goals.

Research on self-efficacy has also investigated and analyzed external factors since self-efficacy beliefs operate within the larger social cognitive theory, in which human functioning influences and is influenced by a variety of circumstances, including the environment. The subsequent subthemes are devoted to a deeper examination of these contextual variables.

2.7 Self-efficacy and Teacher-Student Relationships

Although many studies have examined self-efficacy in relation to strategy, anxiety, and other variables, few have examined external or contextual aspects that are thought to influence the language-learning process and achievement, such as the teacher-student relationship. Ma et al. (2018) analyzed the relationship between achievement and self-efficacy in relation to teacher-student relationships in an EFL context, China. The findings indicated that the teacher-student connection had a significant impact on language achievement and self-efficacy beliefs. This is not surprising, given that schools are sites for fostering self-efficacy, and teachers' feedback is a kind of social persuasion that significantly influences students' sense of efficacy. Regardless of the criticality of this area to self-efficacy, research on it is scarce.

2.8 Self-efficacy and Classroom Setting

Within schools, some studies have investigated the influence of classroom settings on students' EFL efficacy beliefs; Daggol (2019) investigated classroom climate, which refers to students' feelings toward their peers and teachers in classrooms, which are "social, psychological and pedagogical settings where learning happens" (Daggol, 2019, P. 20). The data indicated a favorable correlation between self-efficacy beliefs and classroom climate, and the researcher concluded, "all in all, learning climate and sense of self-efficacy are related to each other. The more positive the learning atmosphere that teachers build, the more efficacious students feel" (p. 30). The findings illustrate the importance of English teachers in relation to the efficacy beliefs of their learners, as they are responsible for creating non-threatening and helpful learning environments. Daemi et al. (2017) also investigated the classroom environment and reported a significant correlation between learners' self-efficacy beliefs and the classroom setting.

Studies that looked at contextual factors regardless of their cruciality are scarce. Probably, studies researching self-efficacy beliefs paid little attention to the fact that these beliefs are embedded within a larger theory, social cognitive theory. Keep in mind that most elements that have been studied as contextual influences, such as teacher-student relationships and classroom atmosphere, occur within schools. More attention needs to be paid to contextual factors, whether in the school or home environments of EFL learners. According to research on self-efficacy beliefs, schools are places where academic self-efficacy can be cultivated, and the studies above validate the relationship between self-efficacy, classroom environment, and teacher-student relationships. There may be a need for additional research that sheds light on these and other possible external factors associated with self-efficacy.

Most of the reviewed studies above demonstrate that exploring relationships between self-efficacy and other variables is dominant. EFL self-efficacy research continues in different learning environments. Specifically, with the advancement of technology, research on the self-efficacy of language learners has been undertaken in non-typical online virtual classrooms. The effectiveness of these classes is primarily dependent on the dedication and self-control of the students. A study examined the relationship between learners' self-efficacy and self-regulation in an online course and found that the relationship was reciprocal. The researchers concluded, "Learners with higher self-efficacy may be more self-regulated in learning. Likewise, learners who demonstrate

better self-regulatory capacity tend to be more self-efficacious” (Su et al., 2018, p. 113). This study and others highlight the intricacy of these beliefs, as they are found to be connected with numerous variables that facilitate language, such as strategies, motivation, objectives, and self-regulation. Indeed, correlational studies have demonstrated its link with a variety of critical variables, but additional research is required to fully comprehend these beliefs.

3. Self-Efficacy and Language Achievement

As language-learning scholars have long been intrigued by characteristics related to language performance, numerous studies have explored this topic in relation to self-efficacy beliefs. Khodadad and Kaur (2016) examined the relationship between self-efficacy and achievement in relation to strategy use and reported that self-efficacy has a direct effect on English achievement. Demir and Okyar (2021) found that self-efficacy predicted learners’ willingness to communicate and English achievement. English achievement, in turn, affected learners’ willingness to communicate indirectly through the mediation of self-efficacy. In another study, self-efficacy was found to have a significant correlation with achievement and to be a strong predictor of it (Asakereh & Yousofi, 2018). This association between self-efficacy and achievement was also reported by Truong and Wang (2019), Hong and Phan (2020), Thompson et al. (2022), and Jaekel (2020).

In addition to examining self-efficacy’s correlation with English achievement in general, some scholars have explored the relationship from the perspectives of skill level, speaking performance (Asakereh & Dehghannezhad, 2015), writing achievement (Sarkhoush, 2013; Zhang & Guo, 2012), reading comprehension (Giladi et al., 2022), listening comprehension (Tabrizi & Saeidi, 2015), and vocabulary (Wu et al., 2013). Similar to the findings above, a positive correlation was reported in all these studies across different EFL contexts, including Turkey, Saudi Arabia, Iran, China, Korea, and Vietnam. This confirms Bandura’s conclusion, “Increased perceived efficacy is accompanied by higher academic attainments” (1997, p. 218).

Numerous studies have investigated correlations between self-efficacy and achievement as well as factors that may influence self-efficacy. Gender was investigated as a variable that could have an influence on EFL learners’ efficacy beliefs. Unlike the association between self-efficacy and achievement, strategy use, and anxiety, the influence of gender on self-efficacy beliefs is not universally accepted. For example, Bonyadi et al. (2012) and Hong (2018) discovered no gender differences in self-efficacy beliefs. Dogan (2016) and Ahmadian and Pasand (2017) found that males had higher self-efficacy views than females. Given this disagreement, it cannot be asserted that gender is a variable that influences self-efficacy views.

4. Experimental Research: Raising Learners’ Self-Efficacy Beliefs

The repeated findings indicated the importance of self-efficacy beliefs to language achievement, resulting in a new line of inquiry concerned with increasing learners’ self-efficacy beliefs. It has to be noted that these initiatives to boost language learners’ self-efficacy are predicated on the belief that self-efficacy is not a personality attribute, but rather is influenced by sources from the surrounding environment and fluctuates accordingly. Additionally, there is a bidirectional relationship between self-efficacy and achievement. In other words, increasing achievement in the form of an experience that gives the learner a sense of mastery can boost self-efficacy, and a heightened sense of efficacy can result in greater accomplishments.

Several techniques have been implemented aiming to enhance EFL learners’ efficacy beliefs. Baleghizadeh and Masoun (2013) examined the influence of continuous self-assessment on learners’ self-efficacy. Students were divided into experimental and control groups; those in the experimental group were required to complete a self-evaluation questionnaire every two weeks. At the end of the semester, the students’ self-efficacy was tested again, and it was reported that the experimental group’s self-efficacy had increased significantly. A similar study by Takarroucht (2022) investigated the influence of self-assessment on learners’ writing self-efficacy development and found that self-assessment functions as a strategy that increases learners’ knowledge and perception of writing and can maximize learners’ sense of efficacy. Likewise, Baleghizadeh and Mortazavi (2014) examined the impact of reflective journal writing on students’ self-efficacy. The participants were divided into four groups, including one control group and three experimental groups; the experimental groups were instructed to keep reflective journals. One group shared their journals with the instructor and received feedback; another group shared their journals with their classmates and received feedback from them; and the final group wrote reflective journals without sharing them with anyone. A variance analysis revealed that students who kept reflective journals had greater self-efficacy beliefs than the control group. The group that shared their journals with their teacher experienced the greatest rise in self-efficacy, followed by those who shared their journals with their classmates. Similarly, Tai (2016) researched the impacts of collaborative online writing and reported that students’ self-efficacy was considerably enhanced after engaging in collaborative writing. This was also found by

Zhang (2018), whose findings demonstrated that the adoption of the genre-based method in writing classes, a writing process thought to provide students with control over their learning, led to a significant rise in students' self-efficacy. The same rise was also significant in a study assessing the effect of an intervention on self-regulated learning; the intervention was found to have a beneficial effect on strategy use and performance (Lu et al., 2017).

Kassem (2019), Oghyanous (2017), and Namaziandost and Çakmak (2020) conducted studies with the same goal of increasing learners' efficacy but with a focus on teaching methods. Namaziandost and Çakmak (2020) used a flipped classroom approach; Kassem (2019) used a student-centered approach; and Oghyanous (2017) used brain-based teaching. All of these student-centered approaches were compared to typical teacher-centered classes. All approaches were found to boost the self-efficacy beliefs of language learners. This was also documented by Ahmadian et al. (2015), who evaluated the effect of dicto-gloss, a student-centered approach, and discovered that the self-efficacy of the treatment group exceeded that of the control group. In addition to adopting a student-centered approach, Bakhtiari (2020) found that explicit strategy instruction increased students' self-efficacy beliefs.

Similar to the aforementioned studies, McLean and Poulshock (2018) not only intended to enhance reading self-efficacy but also increased the amount of reading, which is believed to be connected with an increase in reading self-efficacy. Word target, out-of-class reading, and continuous silent reading were implemented to boost the reading volume and self-efficacy of the students. Only the word-target reading self-efficacy group had a statistically significant gain compared to the other two groups; also, the other groups had decreased their free reading, whereas the word-target group had increased it. Particularly, the data demonstrated that a rise in self-efficacy is accompanied by a change in behavior, in this case, an increase in reading volume. A shift in behavior may explain the difference in achievement. Liu (2013) investigated the impact of a bar venue on learners' speaking self-efficacy beliefs with the goal of raising learners' speaking self-efficacy. The bar was located in the university's English Practice Center, a place where students and faculty can convene in a casual setting to drink and chat entirely in English for the purpose of enhancing their proficiency. It was discovered that those who frequented the pub had much greater English-speaking self-efficacy beliefs.

In conclusion, the frontiers of research on EFL self-efficacy have been expanded by the studies outlined above, from research examining relationships to research testing the application of interventions that enhance efficacy beliefs. Several tactics, including journaling, self-assessment, and the adoption of student-centered approaches, have been used for this goal. In general, it is possible to classify studies that aim to boost the self-efficacy beliefs of English language learners into three types. One, using techniques such as journaling; two, focusing on alternative teaching methods, especially student-centered approaches; and three, seeking to increase students' self-efficacy as well as creating a positive change in behavior, such as increasing the amount of reading or providing learning opportunities outside the classroom, for example, in a bar. The treatments described in the research covered in this review were successful, but most have not been replicated. To ensure the efficacy of each treatment, more trials in a variety of contexts are needed.

This review of literature aimed to address the research conducted in relation to learners' EFL self-efficacy in the past decade. The reviewed studies have yielded essentially comparable results. On the micro level, they observed that self-efficacy beliefs are correlated to increased strategy use, decreased anxiety, motivation—specifically intrinsic motivation—the adoption of mastery goals—the most desirable form of goals—and self-regulation. All of these have been shown to be significantly and positively related to language performance. At the macro level, self-efficacy was also reported to be significantly and positively connected with language achievement. A small number of the reviewed studies examined the relationship between self-efficacy and contextual characteristics, such as teacher-student relationships and the classroom environment. In addition to these areas of study, another line of research explored the effects of various strategies and instructional approaches designed to boost EFL learners' sense of efficacy.

In general, the reviewed studies have focused on three main areas: research examining relationships between different variables and self-efficacy; research examining relationships between learners' language achievements and their self-efficacy beliefs; and experimental research aiming to boost learners' self-efficacy beliefs.

5. Conclusion: Implications for Future Policy and Research

Prior to considering the implications of the review, it is essential to underline the pliable nature of self-efficacy beliefs, which are not fixed but rather flexible. This provides educators with the ability to manipulate possible influencers seeking to reinforce these beliefs. The implications can be categorized into two broad groups: policy and future research.

Policymakers need to understand that the strengthening of these beliefs correlates with academic progress. This is because "many students have difficulty in school not because they are incapable of performing successfully, but because they are incapable of believing that they can perform successfully" (Bandura, 1986, p. 390). As for English language outcomes, earlier research indicated that efficacy beliefs foster interest and intrinsic motivation, which are necessary for learners to make use of the endless online learning opportunities. (Bandura, 1997; Khodadad & Kaur, 2016). This is critically important when one considers the challenges in EFL contexts, such as limited access to English-speaking communities. Therefore, even when the educational process falls short of expectations, the students are equipped with the required beliefs to continue their own learning pursuits. This is much needed in EFL contexts since English exposure is fairly limited and students' desire to venture beyond the classroom is highly prized (Almohammadi, 2023). Policymakers should also address the prevalent teaching approaches and promote student-centered approaches, which the research findings repeatedly indicated had a correlation with an increase in learners' efficacy beliefs.

In terms of future research directions, there is an obvious need for additional research on interventions to improve self-efficacy beliefs, especially remedial programs for students with low self-efficacy beliefs or low language achievement, as such studies seem to be lacking. Interventions, however, should be applicable and simple to implement to facilitate their use by English teachers. As for teachers, there is an apparent need for additional research on the teacher-student relationship and its relevance to students' efficacy beliefs, as well as the ways in which efficacy beliefs mediate the relationship between the teacher-student relationship and student achievement. Additional research is required to determine the quality of this interaction and its impact on the classroom environment. There is also a need for more research to investigate the factors impacting the quality of this interaction as well as interventions to improve it.

Family involvement is another area where EFL self-efficacy research is lacking. Apparently, no research has examined this subject. This area of research is especially complex since it cannot be adequately addressed without examining the drivers of family engagement, including family members' knowledge of English, their economic situation, their values, and their level of education. Such investigations would not only expand the frontiers of research but also advance researchers' understandings of EFL efficacy beliefs.

Methodologically, across many EFL contexts, there appears to be an emphasis on measuring and associating relationships; probably academics should take a step back and examine self-efficacy from a larger perspective using alternative research methodologies. Consideration must be given to the distinctiveness and peculiarities of the various contexts in which efficacy beliefs acculturate. Such research would do justice to the context-sensitive nature of self-efficacy beliefs. Together with the existing studies, this would enable researchers to view both the big picture and the fine details. Such an exhaustive examination of efficacy is required to enhance research in this subject in a variety of ways. Insofar as research implications are concerned, they suggest that the current EFL self-efficacy study is still in its infancy and has numerous unexplored avenues.

References

- Aghaie, R., & Zhang, L. J. (2012). Effects of explicit instruction in cognitive and metacognitive reading strategies on Iranian EFL students' reading performance and strategy transfer. *Instructional Science*, 40(6), 1063-1081. <https://doi.org/10.1007/s11251-011-9202-5>
- Ahmadian, M., Amerian, M., & Lavasani, E. (2015). The effect of the dicto-gloss as a cooperative learning technique on EFL learners' self-efficacy in writing. *Journal of Language Teaching & Research*, 6(6), 1357-1364. <https://doi.org/10.17507/jltr.0606.25>
- Ahmadian, M., & Pasand, P. G. (2017). EFL learners' use of online metacognitive reading strategies and its relation to their self-efficacy in reading. *Reading Matrix: An International Online Journal*, 17(2), 117-132.
- Almohammadi, M. (2023). Rethinking the Potentiality of Self-Efficacy Beliefs for Foreign Language Learning in Saudi Arabia. *International Journal for Cross-Disciplinary in Education*, 14(1), 4732-4736. <https://doi.org/10.20533/ijcdse.2042.6364.2023.0582>
- Alreshoud, A. A., & Abdelhalim, S. M. (2022, 06/01/). The Impact of Self-Regulated Strategy Development on Enhancing Saudi Female English Majors' Reading Comprehension Skills and Self-Efficacy. *Arab World English Journal*, 13(2), 312-327. <https://doi.org/10.24093/awej/vol13no2.21>
- Arslan, A. (2012). Predictive power of the sources of primary school students' self-efficacy beliefs on their self-efficacy beliefs for learning and performance. *Educational Sciences: Theory and Practice*, 12(3), 1915-1920.

- Asakereh, A., & Dehghannezhad, M. (2015). Student satisfaction with EFL speaking classes: Relating speaking self-efficacy and skills achievement. *Issues in Educational Research*, 25(4), 345-363. <https://doi.org/10.17583/ijep.2018.2896>
- Asakereh, A., & Yousofi, N. (2018). Reflective thinking, self-efficacy, self-esteem and academic achievement of Iranian EFL students. *International Journal of Educational Psychology*, 7(1), 68-89. <https://doi.org/10.17583/ijep.2018.2896>
- Bai, B., Chao, G. C. N., & Wang, C. (2019). The relationship between social support, self-efficacy, and English language learning achievement in Hong Kong. *TESOL Quarterly*, 53(1), 208-221. <https://doi.org/10.1002/tesq.439>
- Bai, B., Wang, J., & Nie, Y. (2021). Self-efficacy, task values and growth mindset: What has the most predictive power for primary school students' self-regulated learning in English writing and writing competence in an Asian confucian cultural context? *Cambridge Journal of Education*, 51(1), 65-84. <https://doi.org/10.1080/0305764X.2020.1778639>
- Bailey, D. R., & Rakushin-Lee, A. (2021). Confidence is everything: The mediating effects of self-efficacy on task value and social media participation. *TESL-EJ, The Electronic Journal for English as a Second Language*, 24(4) 1-20.
- Bakhtiari, V. (2020). The effects of raising strategy-awareness on EFL learners' reading achievement and reading self-efficacy in different educational settings. *The Reading Matrix: An International Online Journal*, 20(1), 154-171.
- Baleghizadeh, S., & Masoun, A. (2013). The effect of self-assessment on EFL learners' self-efficacy. *TESL Canada Journal*, 31(1), 42-58. <https://doi.org/10.18806/tesl.v31i1.1166>
- Baleghizadeh, S., & Mortazavi, M. (2014). The impact of different types of journaling techniques on EFL learners' self-efficacy. *Issues in Teachers' Professional Development*, 16(1), 77-88. <https://doi.org/10.15446/profile.v16n1.37184>
- Bandura, A. (1977). Self-Efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Inc.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman and Company.
- Bonyadi, A., Nikou, F. R., & Shahbaz, S. (2012). The relationship between EFL learners' self-efficacy beliefs and their language learning strategy use. *English Language Teaching*, 5(8), 113-121. <https://doi.org/10.5539/elt.v5n8p113>
- Cave, P. N., Evans, N. W., Dewey, D. P., & Hartshorn, K. J. (2018). Motivational partnerships: increasing ESL student self-efficacy. *ELT Journal*, 72(1), 83-96. <https://doi.org/10.1093/elt/ccx027>
- Daemi, M. N., Tahriri, A., & Zafarghandi, A. M. (2017). The relationship between classroom environment and EFL learners' academic self-efficacy. *International Journal of Education and Literacy Studies*, 5(4), 16-23. <https://doi.org/10.7575/aiac.ijels.v.5n.4p.16>
- Daggöl, D. G. (2019). Learning climate and self-efficacy beliefs of high school students in an EFL setting. *Research on Youth and Language*, 13(1), 19-35.
- Demir, Y., & Okyar, H. (2021). A Path-Analytic Study into Foreign Language Enjoyment, Willingness to Communicate in English, Self-Efficacy, and Academic Achievement. *Excellence in Education Journal*, 10(1), 33-69. <https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1307780&site=ehost-live>
- Doğan, C. (2016). Self-efficacy and anxiety within an EFL context. *Journal of Language and Linguistics Studies*, 12(2), 54-65.
- Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*, 61, 1-13. <https://doi.org/10.1016/j.cedpsych.2020.101859>
- Giladi, A., Koslowsky, M., & Davidovitch, N. (2022, 01/01/). Effort as a Mediator of the Relationship between English Learning Self-Efficacy and Reading Comprehension Performance in the EFL Field: A Longitudinal Study. *International Journal of Higher Education*, 11(1), 114-125. <https://doi.org/10.5430/ijhe.v11n1p114>

- Harrington, C., Carter-Templeton, H. D., & Appel, S. J. (2017). Diabetes self-management education and self-efficacy among African American women living with type 2 diabetes in rural primary care. *Journal of Doctoral Nursing Practice*, 10(1), 11-16. <https://doi.org/10.1891/2380-9418.10.1.11>
- He, T. H., Chang, S.-M., Chen, S.-H. E., & Gou, W. J. (2012). Trichotomous goals of elementary school students learning English as a foreign language: A structural equation model. *Perceptual & Motor Skills*, 114(1), 157-173. <https://doi.org/10.2466/08.11.14.PMS.114.1.157-173>
- Heidari, F., Izadi, M., & Ahmadian, M. V. (2012). The relationship between Iranian EFL learners' self-efficacy beliefs and use of vocabulary learning strategies. *English Language Teaching*, 5(2), 174-182. <https://doi.org/10.5539/elt.v5n2p174>
- Hong, N. X., & Phan, N. T. T. (2020). Students' self-efficacy beliefs and TOEIC achievements in the Vietnamese context. *International Journal of Instruction*, 13(4), 67-86. <https://doi.org/10.29333/iji.2020.1345a>
- Hong, S. (2018). Self-efficacy beliefs and effective instructional strategies: U.S. university English learners' perspective. *International Journal of Teaching & Learning in Higher Education*, 30(3), 477-496.
- Jaekel, N. (2020). Language learning strategy use in context: the effects of self-efficacy and CLIL on language proficiency. *International Review of Applied Linguistics in Language Teaching*, 58(2), 195-220. <https://doi.org/10.1515/iral-2016-0102>
- Kassem, H. M. (2015). The Relationship between listening strategies used by Egyptian EFL college sophomores and their listening comprehension and self-efficacy. *English Language Teaching*, 8(2), 153-169. <https://doi.org/10.5539/elt.v8n2p153>
- Kassem, H. M. (2019). The impact of student-centered instruction on EFL learners' affect and achievement. *English Language Teaching*, 12(1), 134-153. <https://doi.org/10.5539/elt.v12n1p134>
- Khodadad, M., & Kaur, J. (2016). Causal relationships between integrative motivation, self-efficacy, strategy use and English language achievement. *Southeast Asian Journal of English Language Studies*, 22(3), 111-125. <https://doi.org/10.17576/3L-2016-2203-08>
- Kim, D.-H., Wang, C., Ahn, H. S., & Bong, M. (2015). English language learners' self-efficacy profiles and relationship with self-regulated learning strategies. *Learning & Individual Differences*, 38, 136-142. <https://doi.org/10.1016/j.lindif.2015.01.016>
- Liu, M. (2013). English Bar as a Venue to Boost Students' Speaking Self-Efficacy at the Tertiary Level. *English Language Teaching*, 6(12), 27-37. <https://doi.org/10.5539/elt.v6n12p27>
- Lu, Y. U., Wen-Juo, L. O., & Lincoln, F. (2017). Effects of intervention on self-regulated learning for second language learners. *Chinese Journal of Applied Linguistics (De Gruyter)*, 40(3), 233-260. <https://doi.org/10.1515/cjal-2017-0014>
- Ma, L., Du, X., Hau, K.-T., & Liu, J. (2018). The association between teacher-student relationship and academic achievement in Chinese EFL context: a serial multiple mediation model. *Educational Psychology*, 38(5), 687-707. <https://doi.org/10.1080/01443410.2017.1412400>
- Ma, L., Du, X., & Liu, J. (2018). Intrinsic and extrinsic value for English learning: Mediation effects of self-efficacy in Chinese EFL context. *Chinese Journal of Applied Linguistics (De Gruyter)*, 41(2), 150-168. <https://doi.org/10.1515/cjal-2018-0009>
- Mann, M. J., Smith, M. L., & Kristjansson, A. L. (2015). Improving academic self-efficacy, school connectedness, and identity in struggling middle school girls: A preliminary study of the REAL girls program. *Health Education & Behavior*, 42(1), 117-126. <https://doi.org/10.1177/1090198114543005>
- McCaffrey, A., Mrazik, M., & Klassen, R. (2014). The relation between self-efficacy, injury and fear of injury among elite athletes. *British Journal of Sports Medicine*, 48(7), 636-636. <https://doi.org/10.1136/bjsports-2014-093494.205>
- McLean, S., & Poulshock, J. (2018). Increasing reading self-efficacy and reading amount in EFL learners with word-targets. *Reading in a Foreign Language*, 30(1), 76-91. <http://nflrc.hawaii.edu/rfl/April2018/articles/mclean.pdf>
- Mohammed, G. M. S. (2022, 01/01/). The Impact of Reading Strategies and Self-Efficacy on Reading Comprehension: The Case of Saudi EFL Learners. *Journal of Language and Linguistic Studies*, 18, 627-639. <https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1328822&site=ehost-live>

- Namaziandost, E., & Çakmak, F. (2020). An account of EFL learners' self-efficacy and gender in the flipped classroom model. *Education and Information Technologies*, 25, 4041-4055. <https://doi.org/10.1007/s10639-020-10167-7>
- Naseri, M., & Zaferanieh, E. (2012). The relationship between reading self-efficacy beliefs, reading strategy use and reading comprehension level of Iranian EFL learners. *World Journal of Education*, 2(2), 64-75. <https://doi.org/10.5430/wje.v2n2p64>
- Oghyanous, P. A. (2017). The effect of brain-based teaching on young EFL learners' self-efficacy. *English Language Teaching*, 10(5), 158-166. <https://doi.org/10.5539/elt.v10n5p158>
- Phakiti, A., Hirsh, D., & Woodrow, L. (2013). It's not only English: Effects of other individual factors on English language learning and academic learning of ESL international students in Australia. *Journal of Research in International Education*, 12(3), 239-258. <https://doi.org/10.1177/1475240913513520>
- Rahimirad, M., & Zare-ee, A. (2015). Metacognitive strategy instruction as a means to improve listening self-efficacy among Iranian undergraduate learners of English. *International Journal of Instruction*, 8(1), 117-132. <https://doi.org/10.12973/iji.2015.819a>
- Roshandel, J., Ghonsooly, B., & Ghanizadeh, A. (2018). L2 motivational self-system and self-efficacy: A quantitative survey-based study. *International Journal of Instruction*, 11(1), 329-344. <https://doi.org/10.12973/iji.2018.11123a>
- Sardegna, V. G., Lee, J., & Kusey, C. (2018). Self-efficacy, attitudes, and choice of strategies for English pronunciation learning. *Language Learning*, 68(1), 83-114. <https://doi.org/10.1111/lang.12263>
- Sarkhoush, H. (2013). Relationship among Iranian EFL learners' self-efficacy in writing, attitude towards writing, writing apprehension and writing performance. *Journal of Language Teaching & Research*, 4(5), 1126-1132. <https://doi.org/10.4304/jltr.4.5.1126-1132>
- Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, 1-10. <https://doi.org/10.1016/j.cedpsych.2019.101832>
- Sener, S., & Erol, I. K. (2017). Motivational orientations and self-efficacy beliefs of Turkish students towards EFL learning. *Eurasian Journal of Educational Research*, 67, 251-267. <https://doi.org/10.14689/ejer.2017.67.15>
- Shirvan, M. E., Khajavy, G. H., Nazifi, M., & Taherian, T. (2018). Longitudinal examination of adult students' self-efficacy and anxiety in the course of general English and their prediction by ideal self-motivation: Latent growth curve modeling. *New Horizons in Adult Education & Human Resource Development*, 30(4), 23-41. <https://doi.org/10.1002/nha3.20230>
- Soysa, C. K., & Wilcomb, C. J. (2015). Mindfulness, self-compassion, self-efficacy, and gender as predictors of depression, anxiety, stress, and well-being. *Mindfulness*, 6(2), 217-226. <https://doi.org/10.1007/s12671-013-0247-1>
- Su, Y., Zheng, C., Liang, J.-C., & Tsai, C.-C. (2018). Examining the relationship between English language learners' online self-regulation and their self-efficacy. *Australasian Journal of Educational Technology*, 34(3), 105-121. <https://doi.org/10.14742/ajet.3548>
- Tabrizi, H. M., & Saeidi, M. (2015). The relationship among Iranian EFL learners' self-efficacy, autonomy and listening comprehension ability. *English Language Teaching*, 8(12), 158-169. <https://doi.org/10.5539/elt.v8n12p158>
- Tai, H. C. (2016). Effects of collaborative online learning on EFL learners' writing performance and self-efficacy. *English Language Teaching*, 9(5), 119-133. <https://doi.org/10.5539/elt.v9n5p119>
- Takarroucht, K. (2022, 01/01/). The Effect of Self-Assessment on the Development of EFL Writing Self-Efficacy: A Case of Algerian Higher Education. *International Journal of Language Education*, 6(2), 157-168. <https://doi.org/10.26858/ijole.v6i2.22065>
- Talsma, K., Schüz, B., Schwarzer, R., & Norris, K. (2018). I believe, therefore I achieve (and vice versa): A meta-analytic cross-lagged panel analysis of self-efficacy and academic performance. *Learning and Individual Differences*, 61, 136-150. <https://doi.org/10.1016/j.lindif.2017.11.015>
- Tavakoli, H., & Koosha, M. (2016). The effect of explicit metacognitive strategy instruction on reading comprehension and self-efficacy beliefs: The case of Iranian university EFL students. *Porta Linguarum*, (25), 119-133. <https://doi.org/10.30827/Digibug.53893>

- Thompson, G., Aizawa, I., Curle, S., & Rose, H. (2022, 01/01/). Exploring the Role of Self-Efficacy Beliefs and Learner Success in English Medium Instruction. *International Journal of Bilingual Education and Bilingualism*, 25(1), 196-209. <https://doi.org/10.1080/13670050.2019.1651819>
- Truong, T. N. N., & Wang, C. (2019). Understanding Vietnamese college students' self-efficacy beliefs in learning English as a foreign language. *System*, 84, 123-132. <https://doi.org/10.1016/j.system.2019.06.007>
- Wu, X. (2003). Intrinsic motivation and young language learners: the impact of the classroom environment. *System*, 31(4), 501-517. <https://doi.org/10.1016/j.system.2003.04.001>
- Wu, X., Lowyck, J., Sercu, L., & Elen, J. (2013). Task complexity, student perceptions of vocabulary learning in EFL, and task performance. *British Journal of Educational Psychology*, 83(1), 160-181. <https://doi.org/10.1111/j.2044-8279.2011.02061.x>
- Yang, P.-L., & Wang, A.-L. (2015). Investigation of the relationship among language learning strategies, English self-efficacy, and explicit strategy instructions. *Taiwan Journal of Tesol*, 12(1), 35-62.
- Yu, X., Wang, P., Zhai, X., Dai, H., & Yang, Q. (2015). The effect of work stress on job burnout among teachers: The mediating role of self-efficacy. *Social Indicators Research*, 122(3), 701-708. <https://doi.org/10.1007/s11205-014-0716-5>
- Zafarmand, A., Ghanizadeh, A., & Akbari, O. (2014). A structural equation modeling of EFL learners' goal orientation, metacognitive awareness, and self-efficacy. *Advances in Language and Literary Studies*, 5(6), 112-124. <https://doi.org/10.7575/aialc.all.v.5n.6p.112>
- Zarei, A. A., & Zarei, N. (2015). The role of language proficiency in self-related personality traits. *Journal on English Language Teaching*, 5(3), 1-11. <https://doi.org/10.26634/jelt.5.3.3559>
- Zhan, Y., Jiang, Y., Wan, Z. H., & Guo, J. J. (2021). Is there an “expectancy× value” effect? Investigating the impact of self-efficacy and learning motives on Chinese undergraduates' use of deep language learning strategies. *The Asia-Pacific Education Researcher*, 30(1), 83-94. <https://doi.org/10.1007/s40299-020-00516-y>
- Zhang, X., Ardasheva, Y., & Austin, B. W. (2020). Self-efficacy and English public speaking performance: A mixed method approach. *English for Specific Purposes*, 59, 1-16. <https://doi.org/10.1016/j.esp.2020.02.001>
- Zhang, Y. (2018). Exploring EFL learners' self-efficacy in academic writing based on process-genre approach. *English Language Teaching*, 11(6), 115-124. <https://doi.org/10.5539/elt.v11n6p115>
- Zhang, Y., & Guo, H. (2012). A study of English writing and domain-specific motivation and self-efficacy of Chinese EFL learners. *Journal of Pan-Pacific Association of Applied Linguistics*, 16(2), 101-121.

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