Learning strategies in pre-service teacher education:
a systematic literature review

Daniel Franciscão[i] [iD]
State University of Campinas, Campinas, SP, Brazil

Evely Boruchovitch[ii] [iD]
State University of Campinas, Campinas, SP, Brazil

Abstract
Learning strategies are tools employed in information processing. As they can be taught, it is essential that pre-service teachers are instructed in this subject to benefit themselves and their future students. Then, this study aimed to conduct a systematic literature review on the learning strategies used by pre-service teachers, analyzing national and international articles published between 2017 and 2022 and indexed in the Educational Resources Information Center, Scientific Electronic Library Online, Science Direct, Scopus, Red de Revistas Científicas de América Latina y el Caribe, España y Portugal, and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes). After examination and verification of inclusion and exclusion inclusion criteria, 14 articles were included in the review. The results revealed that future teachers make moderate use of learning strategies and present different usage profiles. Demographic, academic, and psychological variables were associated with use of these strategies. The need to expand national investigations on this theme is highlighted.

Keywords
cognitive and metacognitive strategies; self-regulated learning; teacher education; systematic review.

As estratégias de aprendizagem na formação inicial de docentes:
uma revisão sistemática da literatura

Resumo
As estratégias de aprendizagem são ferramentas utilizadas no processamento das informações. A respeito de como elas podem ser ensinadas, é imprescindível que professores em formação sejam instruídos acerca da temática de forma a beneficiar a si e a seus futuros alunos. Assim, o presente artigo teve como objetivo realizar uma revisão sistemática das pesquisas sobre as estratégias de aprendizagem utilizadas por estudantes de licenciatura. Foram analisados artigos nacionais e internacionais publicados entre 2017 e 2022 indexados nas bases Educational Resources Information Center, Scientific Electronic Library Online, Science Direct, Scopus, Rede de Revistas Científicas da América Latina e Caribe, Espanha e Portugal e Portal da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior. Após o exame e a verificação dos critérios de inclusão e exclusão, 14 artigos foram incluídos na revisão. Os resultados revelaram que os futuros professores fazem uso moderado das estratégias de aprendizagem e exibem perfis distintos de uso. Variáveis demográficas, acadêmicas e psicológicas se associaram ao relato de uso dessas estratégias. Ressalta-se a necessidade de ampliar as investigações nacionais sobre esse tema.

Palavras-chave
estratégias cognitivas e metacognitivas; aprendizagem autorregulada; formação de professores. revisão da literatura.

1

Estrategias de aprendizaje en la formación inicial docente:

una revisión sistemática de la literatura

Resumen

Las estrategias de aprendizaje son herramientas utilizadas en el procesamiento de la información. En cuanto a cómo pueden ser enseñadas, es imperativo que los docentes en formación sean instruidos en el tema para su beneficio y el de sus futuros alumnos. Por lo tanto, este artículo tuvo como objetivo realizar una revisión sistemática de investigaciones sobre las estrategias de aprendizaje utilizadas por estudiantes de pregrado. Artículos nacionales e internacionales publicados entre 2017 y 2022 indexados en el Educational Resources Information Center, Scientific Electronic Library Online, Science Direct, Scopus, Red de Revistas Científicas de América Latina y el Caribe, España y Portugal y Portal de la Coordinación de Perfeccionamiento del Personal de Educación Superior. Después de examinar y comprobar los criterios de inclusión y exclusión, se incluyeron en la revisión 14 artículos. Los resultados revelaron que los futuros docentes hacen uso moderado de las estrategias de aprendizaje y exhiben diferentes perfiles de uso. Variables demográficas, académicas y psicológicas se asociaron con el reporte del uso de estas estrategias. Se destaca la necesidad de ampliar las investigaciones nacionales sobre este tema.

Palabras clave

estrategias cognitivas y metacognitivas; aprendizaje autorregulado; formación del profesorado; revisión sistemática.

1 Introduction

In recent decades, the construct of self-regulated learning has become a topic of interest among professionals from various segments, including education (ARCOVERDE *et al.*, 2020; GANDA; BORUCHOVITCH, 2018; FRISON, 2016; SCHUNK; GREENE, 2018). Seen as a process that, through regulation of motivational, behavioral, cognitive, and metacognitive factors, enables the control of one's own learning (ZIMMERMAN, 2013), self-regulated learning is crucial for training of autonomous, motivated and strategic individuals (AVILA; FRISON; VEIGA SIMÃO, 2016; GÓES; BORUCHOVITCH, 2020; WEINSTEIN *et al.*, 2011; ZIMMERMAN, 2013). Self-regulated learners skillfully use, among other tools, different cognitive and metacognitive learning strategies, which are key variables in the self-regulation process (WEINSTEIN; ACEE, 2018; ZIMMERMAN, 2000, 2013).

Learning strategies contribute to the acquisition, storage, and retrieval of information (MCCOMBS, 2017; OLIVEIRA; BORUCHOVITCH; SANTOS, 2009; SELI; DEMBO, 2020). They are essential for a proper psychological and environmental context

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

that favors adequate processing of information, as they enable planning, monitoring, and regulation of the behavior, motivation, and emotions of learners (GÓES; BORUCHOVITCH, 2020; MCCOMBS, 2017; PELLISSON; BORUCHOVITCH, 2022; WEINSTEIN; HUSMAN; DIERKING, 2000). Authors highlight that self-regulation skills, such as the use of learning strategies, can and should be taught, especially in initial teacher education. This way, future teachers are expected to overcome the challenges related to training and the profession and promote environments that favor strategic and self-regulated learning in their classes (BANDURA, 2006; BORUCHOVITCH, 2014; CALLAN; SHIM, 2019; CEREZO et al., 2019; GÓES; BORUCHOVITCH, 2020; LAWSON et al., 2018).

Contemporary events, such as the remote learning system due to the COVID-19 pandemic, have only reinforced the fact that learners, especially future teachers, should make extensive use of learning strategies (ANTHONYSAMY; AH CHOO; SOON HIN, 2021; ESTRADA ARAOZ; GALLEGOS RAMOS, 2022; HONG; LEE; YE, 2021; KLEIN et al., 2021; PEREIRA NETO; FARIA; ALMEIDA, 2022). However, unfortunately, the production in Brazil of studies in this field indicates that students in teacher education programs mostly use superficial learning strategies (MARINI; BORUCHOVITCH, 2014), have time management issues, find it difficult to maintain concentration and motivation, report poor use of self-assessment strategies, and tend to use self-handicapping strategies, such as procrastination (ARCOVERDE et al., 2020; GANDA; BORUCHOVITCH, 2016; VERSUTI; ANDRADE; ZERBINI, 2020).

Similarly, international studies show that, even among in-service teachers, it is common to have conceptual and practical gaps regarding this topic, which may eventually generate poor self-efficacy beliefs when teaching self-regulation and then create obstacles when teaching learning strategies and evaluating one's own pedagogical practice, with consequent failure to promote learning environments for self-regulated learning (CALLAN; SHIM, 2019; DE SMUL et al., 2018; DIGNATH; BÜTTNER, 2018; HALAMISH, 2018).

Considering the relevance of learning strategies for pre-service teachers and for daily lives of teachers, future teachers must expand their knowledge about them. Then, our study intends to map national and international descriptive correlational studies that address learning strategies used by pre-service teachers. More specifically, this study

3

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

aims to investigate whether and how often they use these strategies, and which psychological, academic, and demographic variables may be related to such use.

2 Method

This study observed the most recent guidelines for systematic reviews according to the PRISMA model (PAGE *et al.*, 2021). The search was performed between January and March 2022 indexed in the following databases and virtual journals: Science Direct, Scopus, Education Resources Information Center (ERIC), Red de Revistas Científicas de América Latina y el Caribe, España y Portugal (Redalyc), Scientific Library OnLine (SciELO), and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes). This study analyzed studies published between 2017 and 2022.

The descriptors used in the search for international articles addressing the use of learning strategies among learners in teacher education programs were: learning strategies, self-regulated learning, self-regulated students, self-regulated learning strategies, study strategies, study habits, pre-service teachers, student teachers, and teacher education. To search for Brazilian studies on the same theme, the same descriptors were used in Portuguese as well. During the search, Boolean operators (and, or, and not) were used to combine the descriptors, and they could be located anywhere in the studies.

The inclusion criteria of this review were: peer-reviewed descriptive correlational studies, indexed in journals, whose target audience was undergraduate students enrolled in teacher education programs. Review studies, theoretical research, interventional studies, and papers for a target audience other than the one cited above were excluded. A total of 770 studies were identified in the six databases. After the identification, screening, and inclusion stages, 14 studies that met all inclusion criteria were analyzed in detail and included in this review.

3 Results and discussion

Table 1 shows the general characteristics of the studies included in this review. Regarding the origin of the articles, eight different nationalities can be observed. Only

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO

three studies conducted in Brazil were included when compared to international studies (n=11). Also, the studies were conducted from 2019 to 2022. No study was identified in 2017 and 2018. The authors were mostly supported by colleagues, since only two studies were published by a single author.

Data about the use of learning strategies were collected from selected studies through self-report instruments, including the Motivated Strategies for Learning Questionnaire (MSLQ) (PINTRICH *et al.*, 1993) and the Learning and Study Strategies Inventory (LASSI) (WEINSTEIN; PALMER; ACEE, 2016), used in three and two studies, respectively. The other ten instruments were addressed only once. Regarding initial training courses, it should be noted that these studies were mostly investigations of samples that included more than one course, with emphasis on Natural Sciences courses, present in four studies.

Table 1 – Characteristics of studies included in this review

(to be continue)

Authors/year	Country	Type of instrument	Course	Journal
Liu *et al.* (2019)	United States of America	Cognitive and Metacognitive Learning Strategies Scale (LIU *et al.*, 2018)	Pre-service teachers - Physical Education	European Physical Education Review
Häkkinen *et al.* (2019)	Finland	Motivated Strategies for Learning Questionnaire (MSLQ) (PINTRICH *et al.*, 1993)	Various teacher education programs	Journal of Education for Teaching
Jerónimo-Arango, Yaniz-Álvarez-de-Eulate, and Carcamo-Vergara (2020)	Colombia	Questionnaire to assess the learning strategies of university students (GARGALLO; SUÁREZ-RODRÍGUEZ; PÉREZ-PÉREZ, 2014)	Various teacher education programs	Revista Internacional de Investigación en Educación
Körükcü (2020)	Türkiye	Metacognitive Learning Strategies Scale (GÜVEN; ÇÖGENLİ, 2014)	Pre-service teachers - Social Sciences	Metacognition and Learning
Reindl, Tulis, and Dresel (2020)	Germany	Instrument for the assessment of academic learning strategies (WILD; SCHIEFELE, 1992)	Various teacher education programs	Learning and Individual Differences
Muwonge *et al.* (2020)	Uganda	Motivated Strategies for Learning Questionnaire (MSLQ) (PINTRICH *et al.*, 1993)	Pre-service teachers - Sciences	Social Science and Humanities Open

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO

Table 1 – Characteristics of studies included in this review

(conclusion)

Authors/year	Country	Type of instrument	Course	Journal
Boon (2020)	Türkiye	Self-regulated learning perception scale (TURAN, 2009)	Pre-service teachers - Music	International Journal of Music Education
Kingir, Gok, and Bozkir (2020)	Türkiye	Motivated Strategies for Learning Questionnaire (MSLQ) (PINTRICH *et al.*, 1993)	Pre-service teachers - Sciences	Journal of Baltic Science Education
Boruchovitch *et al.* (2020)	Brazil	Learning and Study Strategies Inventory (LASSI) (WEINSTEIN; PALMER; ACEE, 2016)	Various teacher education programs	Educação: Teoria e Prática
Vosniadou *et al.* (2021)	Australia	Open-ended questions about the use of learning strategies	Various teacher education programs	Metacognition and Learning
Özdemir and Önal (2021)	Türkiye	Self-regulated online learning questionnaire (JANSEN *et al.*, 2016)	Various teacher education programs	International Journal of Contemporary Educational Research
Jurišević *et al.* (2021)	Slovenia	Online self-regulated learning questionnaire (BARNARD *et al.*, 2009)	Various teacher education programs	Center for Educational Policy Studies Journal
Dias *et al.* (2021)	Brazil	Learning strategies scale for university students (BORUCHOVITCH *et al.*, 2006)	Pre-service teachers - Chemistry and Biology	Research, Society and Development
Arcoverde *et al.* (2022)	Brazil	Learning and Study Strategies Inventory (LASSI) (WEINSTEIN; PALMER; ACEE, 2016)	Pre-service teachers - Mathematics, Physics, Biological Sciences, and Chemistry	Psicologia: Reflexão e Crítica

Source: Developed by the authors (2023).

Two approaches to the analysis of the use of learning strategies by future teachers were observed in the international articles: characterization of general use and identification of use profiles, with seven international studies addressing the first type of analysis. The first study, by Liu *et al.* (2019), analyzed the learning strategies and motivation of 419 future teachers, using a Likert-scale questionnaire. The results showed moderate use of learning strategies. The most frequent strategies were elaboration and critical thinking. Regarding motivation, those students guided by the

EDUCAÇÃO & FORMAÇÃO
ARTICLE Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO

mastery goal approach used learning strategies more frequently than those students whose goal was to obtain good grades or avoid negative judgments about their ability.

Aiming to explore the learning strategies used by undergraduate and graduate students in teacher education programs, Jerónimo-Arango, Yaniz-Álvarez-de-Eulate, and Carcamo-Vergara (2020) investigated 431 undergraduate students. Data were collected using a Likert-scale questionnaire. The results indicated that, in general, undergraduate students presented a moderate use of learning strategies. The most common strategies were context control and information processing and use, while the least frequent were metacognitive strategies and information search and selection. Among first-year students and end-of-course students, no significant difference was observed in the use of most strategies, except for information search and selection, which was more frequent among end-of-course students.

Boon (2020) analyzed the self-regulatory skills of 222 music students, using a Likert-scale questionnaire. The results indicated moderate use of learning strategies. However, differences were found according to demographic and academic variables. In this sense, female and male students presented different uses of strategies: female students showed higher use of goal setting and planning strategies, while male students reported higher use of help-seeking and group study strategies. Boon (2020) also identified that third-year students, when compared to second-year students, also presented higher use of help-seeking and group study strategies. Statistically significant differences showed that practicing a musical instrument for three or more hours a day was related to the use of strategies to plan, monitor, and evaluate academic experiences. Finally, self-regulated learning was, in general, influenced by the most recent grades of students – higher grades were related to higher proficiency in behaviors of motivation, attitude, planning, use of information processing strategies, and self-assessment.

An extensive study was conducted by Körükcü (2020) on cognitive flexibility and the metacognitive strategies used by 150 future teachers. Data were collected using a Likert scale and indicated high use of metacognitive strategies by students. More specifically, the most frequent strategy was related to the ability to identify environmental preferences during the study, while the least frequent strategy was related to the ability to manage emotions and anxiety along the study. Regarding gender, the use of general

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO

metacognitive, planning, and observation strategies was more frequent among female students. Regarding the moment of the training course, third-year students presented a better performance than the others in the general use of metacognitive strategies and evaluation and emotional control strategies.

Aiming to investigate self-regulated learning in teacher education programs during the period of remote classes as a result of the COVID-19 pandemic and analyze differences according to demographic and academic variables, Özdemir and Önal (2021) collected data from 353 students using a Likert scale. The results showed moderate use of learning strategies and the most frequent strategies were those related to environmental structuring and persistence. Help-seeking and metacognitive and time management skills were less frequently employed, although presenting moderate use. Significant differences were observed in demographic and academic variables: female students had better grades than male students, students reporting good or excellent digital skills had higher grades than those reporting basic skills, and students who dedicated five to six hours a day to online studies had better grades than those who dedicated one to two hours.

Another group of researchers analyzed the experiences of students enrolled in teacher education programs during the period of remote classes related to the COVID-19 pandemic (JURIŠEVIČ *et al.*, 2021). They wanted to identify learning and emotional regulation strategies of 337 students and relate them to the positive experiences they had during the pandemic. A questionnaire about learning strategies and a questionnaire about emotional regulation strategies, both using Likert scales, were the data collection instruments. The most common cognitive and metacognitive strategies among the students were environmental structuring and goal setting. The least common strategies were task strategies, which involved taking notes, writing study questions, and performing extra tasks. The results also indicated that strategies such as time management, goal setting, environmental structuring, and seeking help were positively associated with adaptive emotional regulation strategies, including positive reappraisal, acceptance, and reorientation of planning, and with positive experiences during the pandemic.

Finally, with a questionnaire of open-ended questions, Australian researchers sought to identify and classify the learning strategies used by 366 first-year students of teacher education programs and relate them to their beliefs of self-regulated learning and their academic performance (VOSNIADOU *et al.*, 2021). The students answered two questions – one to identify learning strategies used by them and one to identify the main types of strategies according to the students. The results indicated that most students reported cognitive strategies of low complexity, such as taking notes, repeating, and practicing. The second most frequent group of strategies was resource management, followed by deep cognitive and metacognitive strategies such as selection of key ideas, elaboration, comprehension monitoring, and self-testing. The least frequent group of strategies was planning metacognition. In the second open-ended question, the most important strategies were those related to the management of the study environment and those that involved direct information manipulation.

Among the studies that evaluated the use of learning strategies based on person-centered approaches, the investigation by Häkkinen *et al.* (2019), through a cluster analysis, identified the profiles of 872 students enrolled in teacher education programs, according to their strategic learning and willingness to collaborate. An adapted Likert-scale questionnaire of learning strategies was used to collect data. The use of cognitive, metacognitive, and resource management strategies by students was moderate. However, the profiles obtained in the analysis showed that strategic learning and willingness to collaborate of students were not homogeneous. Most of the sample showed moderate use of strategies and willingness to collaborate. A smaller portion showed moderate use of strategies and low willingness to collaborate. There was also a group of students who showed low use of strategies and moderate willingness to collaborate.

Students with high use of strategies and high willingness to collaborate constituted the fourth most frequent profile, while the least frequent profile represented students with poor use of strategies and low willingness to collaborate. According to the authors, the profiles could be explained by some demographic and academic variables, such as gender, average grade in high school, university admission grade, previous university studies, teaching experience, and anticipated life satisfaction for the next five years.

EDUCAÇÃO & FORMAÇÃO
ARTICLE Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

Also using cluster analysis, Kingir, Gok, and Bozkir (2020) investigated, among other factors, the profiles of 480 pre-service teachers based on their learning strategies, motivational beliefs, and constructivist perceptions of the learning environment. Data were collected using three Likert-scale questionnaires – one for learning strategies, one for motivational beliefs, and one for constructivist perceptions. The demographic and academic variables of students were compared and two groups of students were identified. Profiles were significantly characterized by gender. More precisely, the profile representing female students showed more frequent use of organization, elaboration, rehearsal, effort regulation, metacognitive regulation, and time and environment management strategies when compared to the profile representing male students. Also, female students showed higher use of mastery goal orientation and performance goal orientation. Constructivist perceptions of the learning environment were statistically similar for both groups.

Muwonge *et al.* (2020) investigated the use of self-regulation strategies of 527 future teachers who answered a self-regulation questionnaire. They identified three distinct profiles – the most frequent profile showed high scores for the use of strategies, followed by the profile representing students who reported moderate use, and the profile showing poor use of strategies in all scales of the instrument. The authors also found that high use of strategies by the profiles resulted in stronger motivational beliefs, such as extrinsic orientation, task value, learning control beliefs, self-efficacy, and anxiety.

The article by Reindl, Tulis and Dresel (2020) addressed the emotional, motivational, cognitive, and metacognitive regulation strategies of 469 teacher training students in situations of academic errors. A questionnaire for emotional regulation strategies and a questionnaire for learning strategies, both using Likert scales, were used for data collection. Three distinct groups were identified: one with most students, who presented high scores for the use of adaptive and ambiguous emotional regulation strategies (capable of producing positive and negative impacts on learning) and low scores for maladaptive emotion regulation strategies. The second group referred to more frequent use, characterized by low scores for the use of adaptive strategies and a combination of high scores for ambiguous and maladaptive strategies. The third group was characterized by the frequent use of maladaptive

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

strategies. The results also indicated that students who were able to adaptively regulate emotions after an adverse situation used deep learning strategies more frequently and had a stronger belief in their ability to overcome difficult situations. Also, they managed effort more effectively when compared to those who used adaptive emotional regulation strategies.

Among the Brazilian studies selected for the review, Boruchovitch *et al.* (2020) aimed to identify the study and learning strategies used by 163 university students enrolled in different teacher education programs and analyze them in relation to some demographic and academic variables. A questionnaire addressing academic and demographic variables and the Learning and Study Strategies Inventory (LASSI), both using Likert scales, were answered. In general, the students showed moderate use of the explored strategies. The students showed a better performance in the scale related to the attitudes, while the worst performance was observed for self-testing strategies. Significant differences were observed in study and learning strategies in relation to six of total eight demographic and academic variables analyzed (age, gender, course semester, ethnicity, intention to remain in the course, and self-perception of performance).

Dias *et al.* (2021) investigated the learning strategies used by students of teacher education programs in remote classes using a Likert-scale questionnaire. The results showed that students used less cognitive strategies when compared to metacognitive strategies. Passive and active note-taking and identifying key information during classes were the most frequent cognitive strategies. On the other hand, a low frequency of elaboration strategies involving the creation of questions about the studied subject was also observed. Among the metacognitive strategies, monitoring and regulation of reading, time management and planning were more frequent, while self-assessment was not frequently reported.

Arcoverde *et al.* (2022) analyzed the learning strategies of 220 students in teacher training in Natural Sciences to find differences in the use of these strategies in relation to demographic variables. The results, obtained through the Learning and Study Strategies Inventory, which used a Likert-type scale, indicated that, in general, students presented a moderate use of learning strategies. Students reported good information processing skills as well as motivation and positive attitudes towards

learning. In contrast, they found it difficult to control anxiety, use self-testing strategies, seek help from academic resources, and manage time. Male students reported they were able to deal with anxiety much better than female students. Physics students were able to control anxiety better than the students from other courses. Mathematics and Chemistry students showed significantly more appropriate attitudes and time management when compared to Biological Sciences students. Also, students in the first and second semesters, when compared to those in the sixth to eighth semesters, showed better skills regarding attitude, self-testing, study strategies for tests, and use of academic resources, in addition to strategic and self-regulated learning as a whole. They also reported better control of concentration when compared to students in the middle of the course (third to fifth semester) and students at the end of the course (sixth to eighth semester).

The analysis of all studies included in this review helped identify that, in general, the use of learning strategies by students of teacher courses, in the last six years, has been moderate both in in-person and remote classes due to the COVID-19 pandemic (ARCOVERDE *et al.*, 2022; BOOM, 2020; LIU *et al.*, 2019; JURIŠEVIČ *et al.*, 2021; ÖZDEMIR; ÖNAL, 2021). However, the use of strategies is not homogeneous among these students, and distinct groups can be identified regarding such use (HÄKKINEN *et al.*, 2020; REINDL; TULIS; DRESEL, 2020; MUWONGE *et al.*, 2020).

According to our review, the use of some strategies, such as cognitive strategies of rehearsal and metacognitive strategies of study environment and goal setting management, is more frequent than others, including cognitive strategies of elaboration and metacognitive strategies of self-assessment, planning, preparation for tests and exams, and management of motivation and emotions (ARCOVERDE *et al.*, 2022; BORUCHOVITCH *et al.*, 2020; DIAS *et al.*, 2021; JURIŠEVIČ *et al.*, 2021; KÖRÜKCÜ, 2020; LIU *et al.*, 2019; VOSNIADOU *et al.*, 2021). Although all strategies have their importance and proper moments for use, students, especially those who intend to be teachers, must expand their declarative and conditional knowledge about the use of deep cognitive strategies and metacognitive strategies (GÓES; BORUCHOVITCH, 2020; WEINSTEIN; ACEE, 2018).

EDUCAÇÃO & FORMAÇÃO
ARTICLE Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

The studies included in this review also establish important relationships between strategic self-regulated learning and academic variables (field of knowledge, year of the course, daily study time, semester of the course, self-perception of performance, and intention to continue in the course), demographic variables (gender and age), and motivational and affective variables (ARCOVERDE *et al.*, 2020; BOOM, 2020; BORUCHOVITCH *et al.*, 2020; HÄKKINEN *et al.*, 2020; KINGIR; GOK; BOZKIR, 2020; KÖRÜKCÜ, 2020; ÖZDEMIR; ÖNAL, 2021). They are all valuable data, as they can guide training actions and intervention projects to improve the use of learning and study strategies in teacher training, allowing special attention to groups that need to enhance the use of such strategies (SPURK *et al.*, 2020).

5 Final considerations

Our study aimed to identify the current state of national and international scientific studies addressing the learning strategies used by students in teacher training, in a period of six years. The search found 14 articles, three of which were conducted in Brazil. In general, participants reported moderate use of different strategies for the regulation of cognition and motivational and affective states, enabling a classification into different strategy use profiles. Most studies found important relationships between strategic self-regulated learning and other psychological, academic or sociodemographic variables. This fact reinforces the importance of considering several variables when promoting the use of learning strategies and, consequently, better internal and external conditions for learning.

This study offers valuable contributions to the expansion of knowledge on the subject, thus supporting further studies and intervention projects for future teachers, particularly at the national level after the end of the remote classes due to the COVID-19 pandemic; however, its limitations should be highlighted. The number of databases analyzed in this review, the time frame, the descriptive correlational character, and the variables assessed here are important limitations that should be taken into account in future review studies.

Due to the relevance of learning strategies for future teachers, in terms of overcoming obstacles in pre-service teacher education and teaching them to future

ARTICLE

EDUCAÇÃO & FORMAÇÃO
Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

students, special attention should be dedicated to making learning strategies widely known and used by undergraduate teacher education programs (BANDURA, 2006; BORUCHOVITCH, 2006, 2014; FRISON; VEIGA SIMÃO; CIGALES, 2017; RANDI, 2014). As theorists and evidence suggest that it is possible to teach self-regulation of learning and the use of learning strategies (ARCOVERDE *et al.*, 2022; DEMBO, 2001; ZIMMERMAN, 2000, 2013), the importance of future studies exploring this theme not only in undergraduate teacher education programs, but also in the continuing training of teachers, should be reinforced.

6 Acknowledgments

7 References

ANTHONYSAMY, L.; AH CHOO, K.; SOON HIN, H. Investigating self-regulated learning strategies for digital learning relevancy. *Malaysian Journal of Learning and Instruction*, Sintok, v. 18, n. 1, p. 29-64, 2021. DOI: https://doi.org/10.32890/mjli2021.18.1.2.

ARCOVERDE, Â. R. R. *et al.* Self-Regulated learning of Brazilian students in a Teacher Education Program in Piauí: the impact of a self-regulation intervention. *Frontiers in Education*, Lausanne, v. 5, p. 1-15, 2020. DOI: https://doi.org/10.3389/feduc.2020.571150.

ARCOVERDE, Â. R. R. *et al.* Self-Regulated learning of Natural Sciences and Mathematics future teachers: learning strategies, self-efficacy, and socio-demographic factors. *Psicologia*: Reflexão e Crítica, Porto Alegre, v. 35, n. 1, p. 1-14, 2022. DOI: https://doi.org/10.1186/s41155-021-00203-x.

AVILA, L. T. G.; FRISON, L. M. B.; VEIGA SIMÃO, A. M. Estratégias de autorregulação da aprendizagem: contribuições para a formação de estudantes de Educação Física. *Revista Iberoamericana de Educación*, Madrid, v. 70, n. 1, p. 63-78, 2016. DOI: https://doi.org/10.35362/rie70173.

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO

BANDURA, A. Adolescent development from an agentic perspective. *In*: PAJARES, F.; URDAN, T. (ed.). *Self-Efficacy beliefs of adolescents*. Greenwich: Information Age, 2006. p. 1-43.

BARNARD, L. *et al.* Measuring self-regulation in online and blended learning environments. *The Internet and Higher Education*, [*S.l.*], v. 12, n. 1, p. 1-6, 2009. DOI: https://doi.org/10.1016/j.iheduc.2008.10.005.

BOON, E. T. Self-regulated learning skills of prospective music teachers in Turkey. *International Journal of Music Education*, [*S.l.*], v. 38, n. 3, p. 415-430, 2020. DOI: https://doi.org/10.1177/0255761420909.

BORUCHOVITCH, E. Autorregulação da aprendizagem: contribuições da psicologia educacional para a formação de professores. *Psicologia Escolar e Educacional*, São Paulo, v. 18, n. 3, p. 401-409, 2014. DOI: https://doi.org/10.1590/2175-3539/2014/0183759.

BORUCHOVITCH, E. *et al.* Estratégias de estudo e aprendizagem de estudantes brasileiros em cursos de formação de professores. *Educação*: Teoria e Prática, v. 30, n. 63, p. 1-18, 2020. DOI: https://doi.org/10.18675/1981-8106.v30.n.63.s14683.

BORUCHOVITCH, E. *et al.* A construção de uma escala de estratégias de aprendizagem para alunos do ensino fundamental. *Psicologia*: Teoria e Pesquisa, Brasília, DF v. 22, n. 3, p. 297-304, 2006. DOI: https://doi.org/10.1590/S0102-37722006000300006.

CALLAN, G. L.; SHIM, S. S. How teachers define and identify self-regulated learning. *The Teacher Educator*, [*S.l.*], v. 54, n. 3, p. 295-312, 2019. DOI: https://doi.org/10.1080/08878730.2019.1609640.

CEREZO, R. *et al.* El papel mediador de la autoeficacia y la utilidad entre el conocimiento y el uso de estrategias de autorregulación del aprendizaje. *Revista de Psicodidáctica*, Bizkaia, v. 24, n. 1, p. 1-8, 2019. DOI: https://doi.org/10.1016/j.psicod.2018.08.001.

DE SMUL, M. *et al.* How competent do teachers feel instructing self-regulated learning strategies? Development and validation of the teacher self-efficacy scale to implement self-regulated learning. *Teaching and Teacher Education*, [*S.l.*], v. 71, p. 214-225, 2018. DOI: https://doi.org/10.1016/j.tate.2018.01.001.

DEMBO, M. H. Learning to teach is not enough: future teachers also need to learn how to learn. *Teacher Education Quarterly*, [*S.l.*], v. 28, n. 4, p. 23-35, 2001. Available at: http://www.jstor.org/stable/23478314. Access on: Dec. 10, 2022.

DIAS, S. S. *et al.* Estratégias de aprendizagem no ensino remoto: um estudo com licenciandos em Química e Biologia. *Research, Society and Development*, Vargem Grande Paulista, v. 10, n. 8, p. 1-8, 2021. DOI: https://doi.org/10.33448/rsd-v10i8.17183.

DIGNATH, C.; BÜTTNER, G. Teachers' direct and indirect promotion of self-regulated learning in primary and secondary school mathematics classes – insights from video-based classroom observations and teacher interviews. *Metacognition and Learning*, [*S.l.*], v. 13, n. 2, p. 127-157, 2018. DOI: https://doi.org/10.1007/s11409-018-9181-x.

ESTRADA ARAOZ, E. G.; GALLEGOS RAMOS, N. A. Cansancio emocional en estudiantes universitarios peruanos en el contexto de la pandemia de Covid-19. *Educação & Formação*, Fortaleza, v. 7, p. e6759, 2022. DOI: https://doi.org/10.25053/redufor.v7i1.6759.

FRISON, L. M. B. Autorregulação da aprendizagem: abordagens e desafios para as práticas de ensino em contextos educativos. *Revista de Educação PUC*, *Campinas*, v. 21, n. 1, p. 1-17, 2016. DOI: https://doi.org/10.24220/2318-0870v21n1a2992.

FRISON, L. M. B.; VEIGA SIMÃO, A. M.; CIGALES, J. R. Aprendizagens na docência: Pibid e a formação de professores. *Revista e-Curriculum*, São Paulo, v. 15, n. 1, p. 25-44, 2017. DOI: https://doi.org/10.23925/1809-3876.2017v15i1p25-44.

GANDA, D. R.; BORUCHOVITCH, E. As atribuições de causalidade e as estratégias autoprejudiciais de alunos do curso de Pedagogia. *Psico-USF*, Bragança Paulista, v. 21, n. 2, p. 331-340, 2016. DOI: https://doi.org/10.1590/1413-82712016210210.

GANDA, D. R.; BORUCHOVITCH, E. Self-regulation of Learning: key concepts and theoretical models. *Revista Psicologia da Educação*, São Paulo, v. 1, n. 46, p. 71-80, 2018. DOI: https://doi.org/10.5935/2175-3520.20180008.

GARGALLO, B.; SUÁREZ-RODRÍGUEZ, J. M.; PÉREZ-PÉREZ, C. El cuestionario Ceveapeu. Un instrumento para la evaluación de las estrategias de aprendizaje de los estudiantes universitarios. *Revista Electrónica de Investigación y Evaluación Educativa*, Valencia, v. 15, n. 2, p. 1-31, 2014. DOI: https://doi.org/10.7203/relieve.15.2.4156.

GÓES, N. M.; BORUCHOVITCH, E. *Estratégias de aprendizagem*: como promovê-las. Petrópolis: Vozes, 2022.

GÜVEN, M.; ÇÖGENLİA, G. Validity and reliability of the metacognitive learning strategies scale. *Dicle University Journal of Ziya Gökalp Education Faculty*, [*S.l.*], n. 22, p. 283-297, 2014.

HÄKKINEN, P. *et al.* Finnish pre-service teachers' perceptions of their strategic learning skills and collaboration dispositions. *Journal of Education for Teaching*, [*S.l.*], v. 46, n. 1, p. 71-86, 2019. DOI: https://doi.org/10.1080/02607476.2019.1708628.

HALAMISH, V. Pre-service and in-service teachers' metacognitive knowledge of learning strategies. *Frontiers in Psychology*, [*S.l.*], v. 9, p. 2512-2523, 2018. DOI: https://doi.org/10.3389/fpsyg.2018.02152.

16

ARTICLE

EDUCAÇÃO & FORMAÇÃO
Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO

HONG, J.-C.; LEE, Y.-F.; YE, J.-H. Procrastination predicts online self-regulated learning and online learning ineffectiveness during the coronavirus lockdown. *Personality and Individual Differences*, [*S.l.*], v. 174, p. 1-8, 2021. DOI: https://doi.org/10.1016/j.paid.2021.110673.

JANSEN, R. S. *et al.* Validation of the self-regulated online learning questionnaire. *Journal of Computing in Higher Education*, [*S.l.*], v. 29, n. 1, p. 6-27, 2016. DOI: https://doi.org/10.1007/s12528-016-9125-x.

JERÓNIMO-ARANGO, L. C.; YANIZ-ÁLVAREZ-DE-EULATE, C.; CARCAMO-VERGARA, C. Estrategias de aprendizaje de estudiantes colombianos de grado y posgrado. *Revista Internacional de Investigación en Educación*, Bogotá, v. 13, p. 1-20, 2020. DOI: https://doi.org/10.11144/Javeriana.m13.eaec.

JURIŠEVIČ, M. *et al.* Higher education students' experience of emergency remote teaching during the Covid-19 pandemic in relation to self-regulation and positivity. *Center for Educational Policy Studies Journal*, [*S.l.*], v. 11, p. 241-262, 2021. DOI: https://doi.org/10.26529/cepsj.1147.

KINGIR, S.; GOK, B.; BOZKIR, A. S. Exploring relations among pre-service science teachers' motivational beliefs, learning strategies and constructivist learning environment perceptions through unsupervised data mining. *Journal of Baltic Science Education*, [*S.l.*], v. 19, n. 5, p. 804-823, 2020. DOI: https://doi.org/10.33225/jbse/20.19.804.

KLEIN, P. *et al.* Studying physics during the Covid-19 pandemic: student assessments of learning achievement, perceived effectiveness of online recitations, and online laboratories. *Physical Review Physics Education Research*, [*S.l.*], v. 17, n. 1, p. 1-11, 2021. DOI: https://doi.org/10.1103/PhysRevPhysEducRes.17.010117.

KÖRÜKCÜ, M. The investigation of social studies teacher candidates cognitive flexibility levels and metacognitive learning strategies in terms of different variables. *Asian Journal of Education and Training*, [*S.l.*], v. 6, n. 1, p. 1-11, 2020. DOI: https://doi.org/10.20448/journal.522.2020.61.1.11.

LAWSON, M. J. *et al.* Teachers' and Students' belief systems about the self-regulation of learning. *Educational Psychology Review*, [*S.l.*], v. 31, n. 1, p. 223-251, 2018. DOI: https://doi.org/10.1007/s10648-018-9453-7.

LIU, J. *et al.* Psychometric properties of the cognitive and metacognitive learning strategies scales among preservice physical education teachers: a bifactor analysis. *European Physical Education Review*, [*S.l.*], v. 25, n. 3, p. 616-639, 2018. DOI: https://doi.org/10.1177/1356336X18755087.

LIU, J. *et al.* Self-regulated learning strategies and achievement goals among preservice physical education teachers. *European Physical Education Review*, [*S.l.*], v. 26, n. 2, p. 375-391, 2019. DOI: https://doi.org/10.1177/1356336X19859602.

17

EDUCAÇÃO & FORMAÇÃO
ARTICLE | Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

MARINI, J. A. S.; BORUCHOVITCH, E. Self-Regulated learning in students of Pedagogy. *Paidéia*, Ribeirão Preto, v. 24, n. 59, p. 323-330, 2014. DOI: https://doi.org/10.1590/1982-43272459201406.

MCCOMBS, B. L. Historical review of learning strategies research: strategies for the whole learner - A tribute to Claire Ellen Weinstein and early researchers of this topic. *Frontiers in Education*, [*S.l.*], v. 2, 2017. DOI: https://doi.org/10.3389/feduc.2017.00006.

MUWONGE, C. M. *et al.* Use of self-regulated learning strategies among teacher education students: a latent profile analysis. *Social Sciences & Humanities Open*, [*S.l.*], v. 2, n. 1, p. 1-8, 2020. DOI: https://doi.org/10.1016/j.ssaho.2020.100037.

OLIVEIRA, K. L.; BORUCHOVITCH, E.; SANTOS, A. A. A. Estratégias de aprendizagem e desempenho acadêmico: evidências de validade. *Psicologia*: Teoria e Pesquisa, Brasília, DF, v. 25, n. 4, p. 531-536, 2009. DOI: https://doi.org/10.1590/S0102-37722009000400008.

ÖZDEMİR, A.; ÖNAL, A. an investigation into pre-service teachers' self-regulated online learning perceptions. *International Journal of Contemporary Educational Research*, 2021. DOI: https://doi.org/10.33200/ijcer.865189.

PAGE, M. J. *et al.* The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *British Medical Journal*, [*S.l.*], v. 372, n. 71, p. n71, 2021. DOI: https://doi.org/10.1136/bmj.n71.

PEREIRA NETO, L. L.; FARIA, A. A. G. B. T.; ALMEIDA, L. S. Satisfação acadêmica no contexto da pandemia da Covid-19 em estudantes do Ensino Superior. *Educação & Formação*, Fortaleza, v. 7, p. e8477, 2022. DOI: https://doi.org/10.25053/redufor.v7.e8477.

PELLISSON, S.; BORUCHOVITCH, E. Estratégias de regulação emocional de futuros professores. *Educação & Formação*, Fortaleza, v. 7, p. e7152, 2022. DOI: https://doi.org/10.25053/redufor.v7i1.7152.

PINTRICH, P. R. *et al.* Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (Mslq). *Educational and Psychological Measurement*, [*S.l.*], v. 53, n. 3, p. 801-813, 1993. DOI: https://doi.org/10.1177/0013164493053003024.

RANDI, J. Teachers as self-regulated learners. *Teachers College Record*, [*S.l.*], v. 106, n. 9, p. 1825-1853, 2004. DOI: https://doi.org/10.1111/j.1467-9620.2004.00407.x.

REINDL, M.; TULIS, M.; DRESEL, M. Profiles of emotional and motivational self-regulation following errors: Associations with learning. *Learning and Individual Differences*, v. 77, p. 101806, 2020. DOI: https://doi.org/10.1016/j.lindif.2019.101806.

EDUCAÇÃO & FORMAÇÃO
ARTICLE   Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

SCHUNK, D. H.; GREENE, J. A. Historical, contemporary, and future perspectives on self-regulated learning and performance. *In*: SCHUNK, D. H.; GREENE, J. A. (ed.). *Handbook of self-regulation of learning and performance*. London: Routledge/Taylor & Francis Group, 2018. p. 1-15.

SELI, H.; DEMBO, M. H. *Motivation and learning strategies for college success*: a focus on self-regulated learning. London: Routledge, 2020.

SPURK, D. *et al.* Latent profile analysis: a review and "how to" guide of its application within vocational behavior research. *Journal of Vocational Behavior*, [*S.l.*], v. 120, p. 1-21, 2020. DOI: https://doi.org/10.1016/j.jvb.2020.103445.

TURAN, S. *The relationship between attitudes to problem-based learning, learning skills and achievement.* 2009. Doctoral Dissertation – Hacettepe Medical School, 2009.

VERSUTI, F. M.; ANDRADE, R. B. N. M.; ZERBINI, T. Learning strategies in distance courses: difference between teaching degree and extension courses. *Psicologia*: Teoria e Pesquisa, Brasília, DF, v. 36, p. 1-7, 2020. DOI: https://doi.org/10.1590/0102.3772e3631.

VOSNIADOU, S. *et al.* Beliefs about the self-regulation of learning predict cognitive and metacognitive strategies and academic performance in pre-service teachers. *Metacognition and Learning*, [*S.l.*], 2021. DOI: https://doi.org/10.1007/s11409-020-09258-0.

WEINSTEIN, C. E.; ACEE, T. W. Study and learning strategies. *In*: FLIPPO, R. F.; BEAN, T. W. (ed.). *Handbook of College Reading and Study Strategy Research*. New York: Routledge, 2018. p. 227-240.

WEINSTEIN, C. E.; ACEE, T. W.; JUNG, J. Self-regulation and learning strategies. *New Directions for Teaching and Learning*, [*S.l.*], n. 126, p. 45-53, 2011. DOI: https://doi.org/10.1002/tl.443.

WEINSTEIN, C. E.; HUSMAN, J.; DIERKING, D. R. Self-Regulation interventions with a focus on learning strategies. *In*: BOEKAERTS, M.; PINTRICH, P. R.; ZEIDNER, M. (ed.). *Handbook of Self-Regulation*. New York: Academic, 2000. p. 727-747. DOI: https://doi.org/10.1016/B978-012109890-2/50051-2.

WEINSTEIN, C. E.; PALMER, D. R.; ACEE, T. W. *User's Manual Learning and Study Strategies Inventory*. 3. ed. Texas: H & H, 2016. Available at: https://www.hhpublishing.com/LASSImanual.pdf. Access on: Dec. 10, 2022.

WILD, K. P.; SCHIEFELE, U. Academic learning strategies: results regarding the factorial structures and reliability of a new questionnaire. *Zeitschrift für Differentielle und Diagnostische Psychologie*, [*S.l.*], v. 15, p. 185-200, 1992.

ZIMMERMAN, B. J. Becoming a self-regulated learner: an overview. *Theory Into Practice*, [*S.l.*], v. 41, n. 2, p. 64-70, 2002. DOI: https://doi.org/10.1207/s15430421tip4102_2.

ZIMMERMAN, B. J. From cognitive modeling to self-regulation: a social cognitive career path. *Educational Psychologist*, [*S.l.*], v. 48, n. 3, p. 135-147, 2013. DOI: https://doi.org/10.1080/00461520.2013.794676.

Daniel Franciscão, State University of Campinas (Unicamp)

[i] https://orcid.org/0000-0003-2508-8777

Master's student in Education from Unicamp, Psychology in Education. Teacher training degree in Biological Sciences from Unicamp. Member of the study and research group in Psychopedagogy. Scholarship obtained from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes).
Author contributions: study conception, method, validation, writing, and revision.
Lattes: http://lattes.cnpq.br/1769922305332286
E-mail: daniel.santosf21@gmail.com

Evely Boruchovitch, State University of Campinas (Unicamp), Department of Educational Psychology Psychology

[ii] https://orcid.org/0000-0001-7597-6487

Ph.D. in Education from the University of Southern California, Los Angeles. Psychologist graduated from Universidade do Estado do Rio de Janeiro (UERJ). Full Professor, Department of Educational Psychology, School of Education at Unicamp, research productivity fellow from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) 1B.
Author contributions: study conception, method, validation, writing, and revision.
Lattes: http://lattes.cnpq.br/1980541978397999
E-mail: evely@unicamp.br

How to cite this article (ABNT):
FRANCISCÃO, Daniel; BORUCHOVITCH, Evely. Learning strategies in pre-service teacher education: a systematic literature review. *Educ. Form.*, Fortaleza, v. 8, e10022, 2023. Available at: https://revistas.uece.br/index.php/redufor/article/view/e10022

REDUFOR
REVISTA EDUCAÇÃO & FORMAÇÃO