frontiers in Education

ORIGINAL RESEARCH
published: 28 October 2020
doi: 10.3389/feduc.2020.571150

Self-Regulated Learning of Brazilian Students in a Teacher Education Program in Piaui: The Impact of a Self-Regulation Intervention

Ângela Regina dos Reis Arcoverde[1], *Evely Boruchovitch*[2]*, *Taylor W. Acee*[3] and *Natália Moraes Góes*[4]

[1] Program in Education at School of Education of State University of Campinas (UNICAMP), Campinas, Brazil, [2] Department of Educational Psychology, State University of Campinas (UNICAMP), Campinas, Brazil, [3] Department of Curriculum and Instruction, Texas State University, Austin, TX, United States, [4] Department of Education, State University of Londrina, Londrina, Brazil

OPEN ACCESS

Edited by:
Dan Charles Moos,
Gustavus Adolphus College,
United States

Reviewed by:
Jacqueline Joy Sack,
University of Houston–Downtown,
United States
Khalil Gholami,
University of Kurdistan, Iran

***Correspondence:**
Evely Boruchovitch
evely@unicamp.br

Specialty section:
This article was submitted to Teacher Education, a section of the journal Frontiers in Education

Received: 10 June 2020
Accepted: 29 September 2020
Published: 28 October 2020

Citation:
Arcoverde ÂRdR, Boruchovitch E, Acee TW and Góes NM (2020) Self-Regulated Learning of Brazilian Students in a Teacher Education Program in Piaui: The Impact of a Self-Regulation Intervention. Front. Educ. 5:571150. doi: 10.3389/feduc.2020.571150

Research on teacher education has shown that self-regulated learning (SRL) is relevant for improving learning skills of future teachers. Evidence also suggests that teacher education programs would benefit from fostering SRL in their students and teaching them to use SRL as a teaching practice. This dual focus could help students become more successful students and teachers, better prepared to foster SRL in their future classrooms. The objective of the present research was to investigate learning and study strategies and self-efficacy for learning beliefs among undergraduate students enrolled in teacher education programs at a public university in Brazil. Another aim was to design an SRL intervention, in two formats, and examine the effectiveness of each format at strengthening participants' self-regulatory skills. To achieve these goals, the study was conducted in two phases. In phase 1, 220 participants completed this Learning and Study Strategies Inventory and the Self-efficacy for Learning form. Findings suggested a need for improving future teacher students' self-regulatory skills and provided a basis for the second phase, whose goal was to examine an intervention program using a quasi-experimental research design with three stages: pretest, intervention, and posttest. Three classes were randomly assigned to three different treatment conditions: Experimental Group I (EGI) received theoretical content about SRL and self-reflective questions (format 1), Experimental Group II (EGII) received theoretical content about SRL only (format 2), and the Control Group (CG) only completed the assessments. Data from the first phase were used as pretest measures for the second phase. The sample for phase 2 of this study was composed of 53 students. EGI had 22 students, EGII 12, and CG 19. Results comparing EG I with EG II showed no statistically significant group × time interactions. However, when compared with CG, EGI showed statistically significant gains over the control group on five outcome measures, whereas EG II showed statistically significant

gains over the control group on three of the outcome measures. This suggested benefits to receiving the interventions and that EG I may yield additional benefits over EG II. Theoretical and practical implications for pre-service teachers and teacher education programs are discussed.

Keywords: self-regulation, pre-service teachers, study and learning strategies, self-efficacy for learning, intervention, learning and study strategies, intervention program, self-reflection

INTRODUCTION

The rapid social and technological changes in the world have demanded that students assume an increasingly active role in relation to their learning (Weinstein and Acee, 2018). Traditional teaching methods that encourage passive, rote learning and neglect to teach students how to learn are no longer suited to this new context. To face this challenge, educators must help students to become more strategic and self-regulated lifelong learners. Self-regulated learning refers to students' proactive and intentional use of strategies to exert executive control over their thoughts, feelings, and behaviors in the pursuit of academic learning and achievement goals (Zimmerman, 2002, 2013; Weinstein and Acee, 2018). This involves cognitive, metacognitive, behavioral, and motivational processes.

The cyclical phase model of self-regulated learning developed by Zimmerman (2000); Zimmerman, 2008, Zimmerman (2013) purports that self-regulation consists of an interdependent cyclical process. The model comprises three major phases: forethought, performance, and self-reflection. The forethought phase involves setting learning goals and strategically planning how to reach those goals. The influence and intentional activation of self-motivation beliefs (e.g., self-efficacy) and values (e.g., task interest) are also important aspects within this phase, as is the selection of specific task strategies to be used. Forethought helps to guide and set the stage for learning. The performance phase refers to the implementation of action toward reaching learning goals set and planned for in the forethought phase. This phase involves self-control and self-observation. It is in this phase that students implement learning strategies, monitor their own performance, and record their progress (Zimmerman, 2002, 2013; Schunk and Zimmerman, 2008). The self-reflection phase involves self-judgment and self-reactions. In this phase, students reflect upon results they obtained considering the goals they have set in the forethought phase. Reflection, in turn, helps to inform future goal-setting and strategic planning in future learning situations, hence the cyclical nature of self-regulated learning.

Pintrich (2004) expanded on Zimmerman's model and posited that, during each self-regulatory phase, students can proactively and intentionally regulate cognition, motivation/affect, behavior, and context through SRL processes. Weinstein (1994) developed the Model of Strategic Learning, composed of three major components associated with successful and strategic learning: skill, will, and self-regulation. The skill component of strategic learning emphasizes student's information processing and use of learning strategies. The will component involves student's motivation, attitudes, and feelings toward learning. Students' ability to concentrate, to self-test, to manage their time and strategically use available academic resources are key variables of the self-regulation component of the model. The Model of Strategic Learning assumes interdependence among skill, will, and self-regulation. They are not orthogonal constructs. Zimmerman (2000) and Weinstein (1994) models were used as theoretical frameworks in this study because both consider that learning is a complex and dynamic process that involves monitoring and regulating cognitive, motivational, affective, and behavioral factors. Moreover, these models have been widely used in educational research.

Strategic and self-regulated learning influences students' academic achievement (Schunk and Zimmerman, 2008; Bembenutty, 2011; Weinstein and Acee, 2018). Strategic and self-regulated students know how to employ learning strategies effectively and efficiently and are able to plan, control, and direct their mental processes to achieve their goals. They also actively generate motivational beliefs and emotional states that facilitate learning. They manage the time and effort they need to invest in their academic activities properly. In addition, they create appropriate environments for learning, avoiding distractions, and maintaining concentration on the tasks to be accomplished (Zimmerman, 2000, 2002; Zimmerman and Schunk, 2011; Weinstein and Acee, 2018). A key variable for self-regulated learning is self-efficacy. Self-efficacy beliefs are related to students' judgment of their ability to perform a given task (Bandura, 1986). Research shows that, when students have high self-efficacy beliefs to accomplish a task, their commitment, persistence, and effort are also higher. However, if they do not feel they are able to complete the task successfully, they may fail to instigate and sustain effort toward the task (Bandura, 1997; Zimmerman, 2000, 2002; Pajares and Olaz, 2008; Bzuneck, 2009; Zimmerman and Schunk, 2011).

Self-efficacy beliefs and strategic and self-regulated learning are malleable and can be fostered through educational intervention (Bandura, 1978, 1986; Zimmerman and Schunk, 2011; Zimmerman, 2013; Jakešováa et al., 2015; Erb and Drysdale, 2017; Weinstein and Acee, 2018). Teachers' roles are of paramount importance in fostering student development in these areas across all segments of schooling. Therefore, it is especially important that teacher education programs address self-regulated learning (Schunk and Zimmerman, 2008; Vrieling et al., 2017; Ganda and Boruchovitch, 2018; Michalsky and Schechter, 2018; Yandari et al., 2018; Lawson et al., 2019). In fact, teacher education programs need to provide future teachers not only with specific course content knowledge, but also with knowledge about self-regulatory strategies so they can manage

their learning process, develop academic autonomy, and foster these skills in their future classrooms (Dembo, 2001; Schunk and Zimmerman, 2008; Bembenutty, 2011; Middleton et al., 2011; Moos and Ringdal, 2012; Boruchovitch and Ganda, 2013; Habibi and Yanti, 2017; Poitras et al., 2017; Michalsky and Schechter, 2018; Pérez et al., 2018).

Furthermore, research suggests that university students need to become more proactive, strategic, and self-regulated lifelong learners so they can meet the demands of global economy and modern workforce in rapid evolution (see Pew Research Center, 2016; Weinstein and Acee, 2018). Nevertheless, as the need for greater knowledge, skills, and adaptability in the workforce has increased, the number of students admitted to higher education without appropriate skills to learn has also increased (Bembenutty, 2011; Marini and Boruchovitch, 2014; ACT, 2016; Pavesi and Alliprandini, 2016; Endo et al., 2017; Medeiros and Bittencourt, 2017; Biwer et al., 2020).

Statement of the Problem

Student dropout is a serious problem of Brazilian Higher Education. Dropout rates are even higher in teacher education programs, especially in the areas of Chemistry, Physics, and Mathematics, among others. One of the possible reasons for university dropout is students' insufficient knowledge about and use of learning strategies and study skills to cope with the demands of higher education [Silva and Figueiredo, 2018; Castro et al., 2019; Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP), 2019]. Learning how to self-regulate learning can improve students' self-efficacy about their ability to learn, empower them to achieve success at university, and thus contribute to reduce dropout rates (Bartalo and Guimarães, 2008; Bembenutty, 2011; Araújo et al., 2016). Moreover, research regarding self-regulated learning of students in teacher education programs is very incipient in Brazil when compared with the international literature, especially in undergraduate programs in the areas of Natural Sciences and Mathematics. Given the importance of self-regulated learning for teacher education, the scarce literature on this subject in Brazil, as well as the need to improve education of future teachers in the state of Piauí/Brazil, this study examined self-efficacy for learning beliefs and learning and study strategies of students in teacher education programs and interventions to help them improve in these areas. To achieve these goals, this study was conducted in two phases. First, 220 students enrolled in teacher education programs in the areas of Biological Sciences, Chemistry, Physics, and Mathematics of a Higher Education Institution in the state of Piauí/Brazil completed the Learning and Study Strategies Inventory (LASSI) and the Self-efficacy for Learning form. Findings suggested a need for improving future teacher students' strategic and self-regulatory skills and provided a basis for a quasi-experimental study aimed at designing and examining the effectiveness of a self-regulation intervention program in two formats: (a) theoretical content and self-reflective activities and (b) theoretical content only. The aim of these interventions was to strengthen the self-efficacy beliefs and strategic and self-regulatory skills of undergraduate students. Data gathered in the first phase were used to inform the design of the intervention programs investigated. In addition, participants in the intervention were recruited in the first phase, and their survey data were used to establish a baseline prior to intervention.

Research Questions and Hypotheses

This study was guided by the following research questions and hypotheses:

Research Question 1

To what extent do undergraduate students majoring in Biological Sciences, Chemistry, Physics, and Mathematics report using learning and study strategies and holding robust beliefs of self-efficacy for learning?

There was no specific hypothesis for this research question. Descriptive data were examined to investigate and answer it.

Research Question 2

Can a self-regulated learning intervention program with self-reflection activities (Experimental Group I, EGI) promote higher gains on students' self-reported learning and study strategies and self-efficacy for learning beliefs compared with a self-regulated learning intervention program without self-reflection activities (Experimental Group II, EGII)?

Hypothesis 1

Students who participated in the intervention program with self-reflection (EG I) will show the highest increase in their self-reported learning and study strategies and self-efficacy for learning beliefs from pretest to posttest compared with students who participated in the traditional intervention format (EGII) and to those who did not participate in either of these two intervention formats (Control Group, CG).

Research Question 3:

Will students who participated in a traditional self-regulated intervention program format (EGII) show a significantly higher increase in their self-reported learning and study strategies and self-efficacy for learning beliefs compared with students who did not participate in either of these two intervention formats (CG)?

Hypothesis 2

Students who participated in a traditional self-regulated intervention program format on self-regulated learning (EGII) will show a higher increase in self-reported learning and study strategies and self-efficacy for learning beliefs compared with students who did not participate in either of these two intervention formats (CG).

To answer research questions 2 and 3 and test hypotheses related to them, variables were defined as follows: scores on LASSI and Self-efficacy for Learning form as the dependent variables and groups (EGI, EGII, and CG) and time (pretest and posttest) as the independent variables.

MATERIALS AND METHODS

The Context of the Study

The study was conducted at Higher Education Institution in Piauí, a state in northeast of Brazil. This institution graduates bachelors, basic education teachers in the areas of Biological Sciences, Chemistry, Physics, and Mathematics (licentiate programs) and technologists. The teacher education programs provide 40 positions annually for each of these four majors.

Students who have successfully finished high school and taken the Enem (a Brazilian Nationwide High School Exam) can apply. Entrance in the university is competitive and based on students' scores in the Enem. The purpose of the licentiate programs provided, in addition to supplying the shortage of professionals in the area, is to provide future teachers with a curriculum focused on research and practice in these aforementioned fields. This higher education institution is oriented toward the promotion of educational practices compatible with the principles of democratic society, the dissemination and improvement of ethical values, and the respect for cultural diversity among their teachers-to-be students. The curricular components are grouped around major dimensions: general knowledge, specific knowledge, interdisciplinary knowledge, and psychological and pedagogical knowledge applied to teaching. In addition to theoretical courses, students need to undergo 400 h of supervised internships in schools, 100 h per year, during their undergraduate program. While teachers of specific content areas in this education program are more inclined to use teacher-centered approaches in their classes, teachers of pedagogical, educational psychology, general, and interdisciplinary courses of this teacher education program are more oriented toward student-centered perspectives. The academic year in this institution is divided into two semesters. The first usually begins in February and ends in July. The second starts in August and ends in December. It usually takes a minimum of 4 years and a maximum of 8 years for students to obtain a licentiate degree. Students can enroll in 8 courses per semester. Credit is awarded for each course taken. To be approved in the classes taken, students need to attain a minimal final grade of 7.0 out of 10.0 and attendance of 75% out of 100%. If students fail in a given course, they have opportunity to take it again whenever it is offered again, but no more than twice.

Participants

The sample in phase 1 consisted of 220 students from 16 classes of licentiate degree programs in Biological Sciences (n = 70; 31.82%), Chemistry (n = 51; 23.18%), Physics (n = 53; 24.09%), and Mathematics (n = 46; 20.91%) of a Brazilian Federal Education Institution in the state of Piauí. All students in each program participated in the study and provided complete data. Ages ranged from 17 to 56 years. Mean age was 22.34 years and standard deviation was 6.485. Of the total sample, 93 (42.66%) were aged under 20 years, 100 (45.87%) were aged between 20 and 29 years, and 25 (11.47%) were aged over 30 years. Regarding gender, 101 (45.91%) were female and 119 (54.09%) were male. Of the total sample, 131 students (59.54%) were from the first and second semesters, 48 (21.82%) were from the 3rd to the 5th semesters, and 41 (18.64%) were from the 6th to the 8th semesters.

The sample in phase 2 of the study consisted of 53 sophomore students who completed phase 1 of the study and were in their third semester of a licentiate teacher-education degree program in a Brazilian Federal Education Institution in the state of Piauí. Students were seeking licentiate plans in Chemistry, Physics, and Biology and belonged to three different classes according to their majors. Classes were randomly assigned to treatment conditions (EGI, EGII, or CG), instead of their originally scheduled content. EGI had 22 students seeking a licentiate degree in Chemistry, 10 (45.45%) females and 12 (54.55%) males. In relation to age, 14 (63.64%) students were aged under 20 years, 6 (27.27%) were aged between 20 and 29 years and 2 (9.09%) were aged over 30 years. Mean age was 20.73 and standard deviation was 4.131. EGII had 12 students seeking a licentiate degree in Physics, 8 (66.67%) males and 4 (33.33%) females. Regarding age, 7 (58.33%) students were aged under 20 years, 4 (33.33%) were aged between 20 and 29 years and 1 (8.33%) was aged over 30 years. Mean age was 21.92 and standard deviation was 5.959. CG had 19 students seeking a licentiate degree in Biological Sciences, 13 (68.42%) females and 6 (31.58%) males. Of these students, 10 (52.63%) were aged under 20 years, 6 (31.58%) were aged between 20 and 29 years, and 3 (15.79%) were aged over 30 years. Mean age was 21.79 and standard deviation was 5.544. All three groups were attending both psychological and pedagogical and specific knowledge classes, being exposed to both learner-centered and teacher-centered approaches at the time the intervention program was conducted. Comparison of the three groups in the pretest showed they were very similar regarding major demographic variables and concerning their scores in the LASSI and Self-efficacy scales, except for the self-testing scale of the LASSI, in which EGII students scored significantly higher than EGI students. No other significant initial differences were observed between groups.

Description of the Intervention and Control Conditions

The intervention program designed for phase 2 was conducted in March and April 2019. It consisted of 10 meetings of 3 h each, twice a week. The first and last meetings were used for application of pretest and posttest measures. The eight remaining meetings were dedicated to the intervention program designed in two formats (theoretical/self-reflective and theoretical only). Both EGI and EGII took part in a self-regulated program. While EGI students received, in addition to theoretical content, activities heavily focused on the development of self-regulation, such as self-reflective activities, metacognitive tasks, and explicit guidelines on how to apply the content to their own learning, EGII students participated in a traditional format, only with lectures focused just on the learning of content with no stimulation of self-reflection and self-awareness. CG did not attend any program on self-regulated learning before the pretest and posttest, instead, the class consisted of 10 sessions of open study hall without instruction. In EGI, the meetings were organized into five stages: (a) initially students responded to conceptual and self-reflective questions about the theme to be taught in the meeting; (b) their answers were then discussed; (c) practical activities related to the theme were proposed and followed by a group discussion related to students' performance in these activities; (d) students were then exposed to theoretical content, as well as to relevant research evidence about the theme and its relation to successful learning introduced via Power Point slides; and (e) the meeting finished with the students' written answer to a question about what they had

learned in the meeting. The intervention program for both groups (EGI and EGII) was planned to cover the main variables of the theoretical model of Self-regulated Learning proposed by Zimmerman (2000, 2002) and of the Strategic Learning Model developed by Weinstein (1994). Themes were related to cognitive and metacognitive strategies, as well as to emotional and motivational regulation. Learning strategies, motivation to learn, time management strategies, emotional regulation, and anxiety are some examples of the subjects taught. The classes were taught to students of both EGI (theoretical/self-reflective activities) and EGII (traditional theoretical approach) by the first author of this study. **Tables A1, A2** present, respectively, the themes, goal targeted and activities of each class for EGI and EGII, showing how the content and variables taught featured both the self-reflective intervention approach and the traditional approach (see **Appendix A**).

Instruments

Sociodemographic Questionnaire

The sociodemographic questionnaire contained four multiple-choice questions about students' age, gender, program, and program semester which were used to describe the participants.

Learning and Study Strategies Inventory Third Edition (LASSI 3rd ed.; Weinstein et al., 2016)—Translated and Adapted by Boruchovitch et al. (2019)

The LASSI (3rd ed.) is a Likert-type scale containing 60 items, with 5 choices for answers: not at all typical of me, not very typical of me, somewhat typical of me, fairly typical of me, and very much typical of me. Of its 60 items, 34 have reverse scores, due to the directionality in which they were written. The LASSI items are subdivided into 10 scales: Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-Testing, Test Strategies, Time Management, and Using Academic Resources. Each scale consists of 6 items. Weinstein et al. (2016) mentioned that LASSI scores can be analyzed considering each scale separately. Thus, scores can range from 6 (minimum score) to 30 (maximum score) in each scale. The 10 scales are associated with either the Skill, Will, or Self-Regulation components of strategic learning according to the Model of Strategic Learning (Weinstein et al., 2016). More precisely, Information Processing, Selecting Main Ideas, and Test Strategies scales are related to the Skill component. Anxiety, Attitude, and Motivation scales are associated with the Will component. Concentration, Self-testing, Time Management, and Using Academic Resources are related to the Self-regulation component.

The Anxiety scale assesses the degree to which students worry about college and their academic performance (example item: "when I am taking a test, worrying about doing poorly interferes with my concentration"). The Attitude scale examines students' attitudes and interests regarding college and reaching academic success (example item: "I have a positive attitude about attending my classes"). The Concentration scale assesses students' ability to direct and maintain their attention on academic tasks (example item: "I find it difficult to maintain my concentration while doing my coursework"). The Information Processing scale examines the extent to which students use visual and verbal elaboration, organizational, and other active-thinking strategies to help them learn and remember new information (example item: "to help me remember new principles we are learning in class, I practice applying them"). The Motivation scale assesses students' diligence, self-discipline, and effort to accomplish their academic tasks (example item: "When work is difficult, I either give up or study only the easy parts").

The Selecting Main Ideas scale assesses students' skills at tracing important information to study in various learning situations in college (example item: "I have difficulty identifying the important points in my reading"). The Self-Testing scale measures students' use of strategies for monitoring their comprehension of course material and checking their ability to demonstrate their learning (example item: "I stop periodically while reading and mentally go over or review what was said"). The Test Strategies scale verifies the strategies used by students both at the time of preparation for a test and at the time the test is taken (example item: "I have difficulty adapting my studying to different types of courses"). The Time Management scale measures the use of time management principles and practices by students when performing academic tasks (example item: "when I decide to study, I set aside a specific length of time and stick to it"). Lastly, the Using Academic Resources scale assesses the students' willingness to use different academic resources (example item: "when I am struggling in one or more courses, I am too embarrassed to admit it to anyone"). All 10 scales have high internal consistencies, measured by Cronbach's Alpha, in studies carried out in large samples of American students. The values ranged from 0.76 to 0.87.

The LASSI 3rd edition (Weinstein et al., 2016) was developed with 3 main purposes: (a) to refine the wording of some items from the previous editions of 1988 and 2002; (b) to include a new scale—Using Academic Resources—replacing the Study Aids scale, to better reflect the advances of contemporary educational psychology and postsecondary educational practice; and (c) to decrease its application time by reducing it from 80 to 60 items.

Boruchovitch et al. (2019) have described in detail the process of translating the LASSI (3rd ed.) into Portuguese and adapting it for use with university students in Brazil. In short, the process involved an initial translation conducted by three Brazilian researchers well-versed in research on the LASSI and the Model of Strategic Learning and fluent in both Brazilian Portuguese and American English. Back translation carried out by an expert translator with a Ph.D. in English and fluent in Portuguese led to further refinements and those refinements were again back translated. After those revisions were complete, the translated version was submitted to two expert judges from Brazil and the backtranslation was sent to one of the original authors of the LASSI, all of whom confirmed the adequacy of the translation and adaptation with no suggested revisions.

Self-Efficacy for Learning Form (Zimmerman and Kitsantas, 2005)—Translated to Portuguese by Boruchovitch and Ganda (2010)

This Likert-type scale consisted of 19 items that refer to the self-efficacy beliefs related to 3 academic activities: study, preparation for tests, and note-taking in class. The options assumed values

ranging from 0 to 100%, according to the following gradation: 0% (Definitely cannot do it), 30% (Probably cannot do it), 50% (Maybe can do it), 70% (Probably can do it), and 100% (Definitely can do it). The total score ranged from 0 to 100. A participant score was the mean of the sum of all items (Simmons and Lehman, 2015). Higher scores reflect more positive beliefs in self-efficacy for learning. Some examples of items are: "When you are trying to understand a new topic, can you associate new concepts with the old ones sufficiently well to remember them?" and "When you think you did poorly in a test you just finished, can you go back to your notes and locate all the information you had forgotten?"

The questionnaire was translated into Portuguese by Boruchovitch and Ganda (2010) after obtaining formal consent from the authors. To ensure accuracy, the form was independently translated by two fluent English speakers. The translations were then compared and discussed to determine the final Brazilian version. Back translation procedures were also employed.

The internal consistency of the scale, measured by Cronbach's alpha, was 0.97 in a study conducted with 223 undergraduate students (Zimmerman and Kitsantas, 2007). In a Brazilian study carried out with a sample of 884 undergraduate students (Boruchovitch et al., 2015), the alpha value was high ($\alpha = 0.99$) and similar to that obtained by the original authors. Temporal stability was also measured in another Brazilian study (Balsas and Boruchovitch, 2015). A high and significant correlation was found between the two applications ($\alpha = 0.89$; $p < 0.001$).

Pretest Instruments

The Learning and Study Strategies Inventory (LASSI) and the Self-efficacy for Learning Form applied in the first step were used as pretest measures for the intervention study.

Instruments Applied in the Intervention

Different assessment tools and self-reflective activities related to learning strategies, emotional regulation, and motivational regulation were applied to students during the intervention format 1 and are described in **Table A1**.

Posttest Instruments

The same instruments applied in pretest were re-applied as posttest measures.

Data Collection Procedure

The project was first submitted to and approved by the Research Ethics Committee of the Faculty of Education of a Brazilian public university (Protocol CAAE: 02209218.6.0000.8142), in compliance with the current standards of the National Health Council, Resolution no. 510/2016, which establishes the ethical issues of research conducted with human beings in Brazil. Then, an invitation letter was sent to the undergraduate chairs requesting authorization to carry out the research. They showed great interest in the research due to its relevance to understanding and improving university student learning. Data collection was scheduled after consulting the teachers of each course about the most appropriate days and times for it. All the sixteen classes (100%) of Biological Sciences, Chemistry, Physics, and Mathematics licentiate degree programs provided in the first semester of 2019 participated in the study. Courses were offered in the morning, afternoon, and at night. The instruments were applied in the classrooms by the first author at the same time in the academic calendar for all students. Part of the sample ($n = 118$; 53.63%) answered the instruments online using a link provided to them and the other part of the sample ($n = 102$; 46.36%) answered them in a paper-and-pencil format, due to frequent Internet connectivity problems at the institution. Data collection procedures were the same in all classes. The researcher first explained to the students the objectives of the study and the data collection procedures, leaving students free to participate or not in the research. Soon after, the researcher made the research link available to participants. Students were asked to click the link and register their emails. The researcher then sent another link to students' registered emails with an invitation for participation in the research. By accessing the link using smartphones, laptops, and/or tablets, students were directed to the *Autorregular* Platform, which hosted the informal consent form, sociodemographic questions, LASSI (web version), and Self-efficacy for Learning form. Students unable to access the link due to Internet connectivity problems answered all the instruments in paper-and-pencil format. Data collection in each class lasted approximately 50 min.

Data were also collected in pretest and posttest of the intervention study. EGI and EGII students answered the pretest and posttest measures in the first and last days of the intervention. Data collection in the CG was conducted in previously scheduled days and was concurrent with those of the experimental groups. Data collection followed the same procedures described in phase 1 of the study, and lasted approximately 50 min each.

Data Analysis Procedure

Data were analyzed using descriptive and inferential statistics. The Statistical Package for Social Sciences—SPSS version 22 was used. Means, median and standard deviations were calculated and used to examine the research question related to phase 1. Moreover, Cronbach's alpha coefficient was employed to estimate the internal consistency of the scales. For phase 2 data, repeated measures analysis of variance was carried out to compare scores in the scales between EGI and EGII, EGI and CG and EGII and CG and across time (pretest and posttest), followed by Tukey's *post-hoc* tests for between group comparisons and profile tests by contrast for within group comparisons. Effect sizes were examined using eta squared (Bakeman, 2005) and following the criteria described in Cohen (1988) in which eta squared = 0.02 is considered small, eta squared = 0.13 is medium and eta squared = 0.25 is large. The significance level was set at $\alpha < 0.05$ for all analyses.

RESULTS

The objective of Phase 1 of the study was to investigate the learning and study strategies and the self-efficacy for learning beliefs of students enrolled in licentiate degree programs in Biological Sciences, Chemistry, Physics, and Mathematics of a higher education institution in the state of Piauí/Brazil. **Table 1** presents the results of the descriptive analysis of the Brazilian translation of the LASSI 3rd Ed.

TABLE 1 | Alpha values, means and median of the total sample in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the self-efficacy for learning form.

Brazilian translation of the Learning and Study Strategies Inventory—LASSI 3rd Ed.						
			***N* = 220**			
Scale	**α**	**Mean**	**Sd**	**Min**	**Mdn**	**Max**
1. Anxiety	0.821	2.88	0.92	1.00	3.00	4.83
2. Attitude	0.606	4.13	0.53	2.33	4.17	5.00
3. Concentration	0.739	3.44	0.74	1,17	3.50	4.83
4. Information processing	0.723	3.64	0.68	1.33	3.67	5.00
5. Motivation	0.621	3.71	0.63	1.67	3.83	5.00
6. Selecting main ideas	0.714	3.45	0.72	1.17	3.50	4.83
7. Self-testing	0.726	3.13	0.81	1.00	3.17	5.00
8. Test strategies	0.674	3.52	0.70	1.83	3.50	5.00
9. Time management	0.704	3.14	0.73	1.33	3.17	4.83
10. Using academic resources	0.448	3.05	0.63	1.00	3.00	4.67
Total LASSI	0.899	3.41	0.43	2.20	3.44	4.57
Brazilian translation of the self-efficacy for learning form						
			***N* = 220**			
Total self-efficacy	0.910	66.48	13.62	12.11	68.95	98.95

Source: authors (2020).

and of the Brazilian translation of the Self-efficacy for learning Form.

Except for the Using Academic Resources scale (α = 0.448), the reliability of the LASSI scales, estimated by Cronbach's alpha, ranged from moderate to high (α = 0.606–α = 0.899). Overall, alpha values obtained in the present study were similar to those found by Bartalo and Guimarães (2008) in a Brazilian sample with the LASSI 2nd edition. Attitude, motivation, and test-taking strategies had alpha values ranging from 0.606 to 0.674, which can be considered acceptable in Human Sciences (Prieto and Muñiz, 2000). As the psychometric properties of the Brazilian version of the LASSI are still under study, no item was removed yet to raise reliability. The reliability of the Self-efficacy for Learning Form was high as in its original studies (Zimmerman and Kitsantas, 2007) and in other Brazilian studies (Boruchovitch and Ganda, 2013; Ganda and Boruchovitch, 2018).

The LASSI total mean was 3.41 (SD = 0.43) and the median was 3.44, suggesting that students report using learning and study strategies to a certain extent. The anxiety scale had the lowest mean and median (M = 2.88; SD = 0.92 Mdn = 3.00) followed by the use of academic resources scale (M = 3.05; SD = 0.63; Mdn = 3.00), self-testing (M = 3.13; SD = 0.81; Mdn = 3.17) and time management (M = 3.13; SD = 0.73; Mdn = 3.17). The attitude scale has the highest values (M = 4.13; Mdn = 4.17). Overall, there were no huge variations in students' answers, in the different LASSI scales. The Self-efficacy for Learning form mean was 66.48 and the median was 68.95, which indicates a moderate sense of self-efficacy for learning among students in the sample.

Table 2 shows results of the comparisons of scores in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the Self-efficacy for learning form between groups (EGI and EGII) and between times (pretest and posttest) of phase 2 of the present study.

Repeated measures analysis of variance (Anova) was carried out to compare scores on LASSI scales and Self-efficacy for learning form between groups (EGI and EGII) and between times (pre-test × posttest) to examine whether intervention program (self-reflective and theoretical formats) contributed to changes in participants' scores on these outcome measures over time. Anova results comparing EG I to EG II showed no statistically significant group × time interactions, suggesting that these two groups did not differ significantly in how they changed over time in the outcome measures. In consonance, data suggest that both intervention formats were equivalent.

Profile test by contrast was employed to examine whether EGI and EGII differed significantly between times. Data revealed that from pretest to posttest participants of EGI improved significantly their scores on LASSI information processing (Mpre = 3.41; Mpos = 3.79, $p < 0.001$), self-testing (Mpre = 2.74; Mpos = 3.07, $p = 0.010$), total LASSI scales (Mpre = 3.09; Mpos = 3.30, $p = 0.028$), and on self-efficacy for learning Form (Mpre = 55.98; Mpos = 63.64, $p = 0.005$). EGII also showed a significant increase in scores of LASSI scales of test strategies (Mpre = 3.11; Mpost = 3.49, $p = 0.035$) and of time management (Mpre = 2.71; Mpost = 3.06, $p = 0.025$) from pretest to posttest. Effect sizes were analyzed according to Cohen (1988). In EGI, they were large for information processing and medium for self-testing, total

TABLE 2 | Anova results for repeated measures: comparisons of scores in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the Self-efficacy for learning Form between groups (EGI and EGII) and between times (pretest and posttest).

Variable*	Comparisons between groups (EG I and EG II)	Effect size eta squared (η^2)	Comparisons between times (pretest and posttest)	Effect size eta squared (η^2)	Interactions groups × times	Effect size eta squared (η^2)
Total self-efficacy	$F_{(1,32)} = 0.68$; $p = 0.414$	$\eta^2 = 0.021$	$F_{(1,32)} = 9.15$; $p = 0.005$[a]	$\eta^2 = 0.222$	$F_{(1,32)} = 0.04$; $p = 0.852$	$\eta^2 = 0.001$
LASSI/ANX	$F_{(1, 31)} = 2.51$; $p = 0.123$	$\eta^2 = 0.075$	$F_{(1, 31)} = 0.61$; $p = 0.440$	$\eta^2 = 0.019$	$F_{(1, 31)} = 0.94$; $p = 0.341$	$\eta^2 = 0.029$
LASSI/ATT	$F_{(1, 31)} = 4.06$; $p = 0.053$	$\eta^2 = 0.116$	$F_{(1, 31)} = 0.06$; $p = 0.808$	$\eta^2 = 0.002$	$F_{(1, 31)} = 0.63$; $p = 0.435$	$\eta^2 = 0.020$
LASSI/CON	$F_{(1, 31)} = 0.65$; $p = 0.427$	$\eta^2 = 0.020$	$F_{(1, 31)} = 1.12$; $p = 0.299$	$\eta^2 = 0.035$	$F_{(1, 31)} = 0.18$; $p = 0.675$	$\eta^2 = 0.006$
LASSI/INP	$F_{(1, 31)} = 0.29$; $p = 0.595$	$\eta^2 = 0.009$	$F_{(1, 31)} = 13.83$; $p < 0.001$[b]	$\eta^2 = 0.308$	$F_{(1, 31)} = 0.04$; $p = 0.845$	$\eta^2 = 0.001$
LASSI/MOT	$F_{(1, 31)} = 0.13$; $p = 0.717$	$\eta^2 = 0.004$	$F_{(1, 31)} = 3.18$; $p = 0.084$	$\eta^2 = 0.093$	$F_{(1, 31)} = 0.01$; $p = 0.927$	$\eta^2 = 0.000$
LASSI/SMI	$F_{(1, 31)} = 0.20$; $p = 0.658$	$\eta^2 = 0.006$	$F_{(1, 31)} = 0.44$; $p = 0.512$	$\eta^2 = 0.014$	$F_{(1, 31)} = 0.09$; $p = 0.760$	$\eta^2 = 0.003$
LASSI/SFT	$F_{(1, 31)} = 7.06$; $p = 0.012$[c]	$\eta^2 = 0.186$	$F_{(1, 31)} = 7.65$; $p = 0.010$[c]	$\eta^2 = 0.198$	$F_{(1, 31)} = 0.00$; $p = 0.981$	$\eta^2 = 0.000$
LASSI/TST	$F_{(1, 31)} = 0.88$; $P = 0.355$	$\eta^2 = 0.028$	$F_{(1, 31)} = 4.89$; $p = 0.035$[d]	$\eta^2 = 0.135$	$F_{(1, 31)} = 0.44$; $p = 0.512$	$\eta^2 = 0.012$
LASSI/TMT	$F_{(1, 31)} = 0.22$; $p = 0.642$	$\eta^2 = 0.007$	$F_{(1, 31)} = 5.58$; $p = 0.025$[e]	$\eta^2 = 0.152$	$F_{(1, 31)} = 0.21$; $p = 0.646$	$\eta^2 = 0.006$
LASSI/URA	$F_{(1, 31)} = 1.34$; $p = 0.257$	$\eta^2 = 0.041$	$F_{(1, 31)} = 2.57$; $p = 0.119$	$\eta^2 = 0.076$	$F_{(1, 31)} = 0.07$; $p = 0.796$	$\eta^2 = 0.002$
Total LASSI	$F_{(1, 31)} = 0.58$; $p = 0.450$	$\eta^2 = 0.019$	$F_{(1, 31)} = 5.28$; $p = 0.028$[f]	$\eta^2 = 0.145$	$F_{(1, 31)} = 0.23$; $p = 0.636$	$\eta^2 = 0.006$

**Variables transformed into ranks in the analysis due to the absence of Normal distribution.*
[a]Significant differences between times (Profile test by contrast): Pre≠ Post for EGI.
[b]Significant differences between times (Profile test by contrast): Pre≠ Post for EGI.
[c]Significant differences between groups (Tukey test): EGI≠ EGII in Pre and Post; significant differences between times (profile test by contrast): Pre≠ Post for EGI.
[d]Significant differences between times (Profile test by contrast): Pre≠ Post for EGII.
[e]Significant differences between times (Profile test by constrast): Pre≠ Post for EGII.
[f]Significant differences between times (Profile test by contrast): Pre≠ Post for EGI.
Source: authors (2020).

LASSI scales and Self-efficacy for learning form. In EGII effect sizes were medium for both test strategies and time management LASSI scales.

Moreover, Tukey test was used to analyze whether there were differences between groups. Results showed that EGI and EGII differed significantly in LASSI self-testing scale with higher scores for EGII both in pre and posttest (Mpre = 3.26; Mpost = 3.61; $p = 0.012$). Effect size was medium. The significantly higher self-testing scores of EGII at pretest remained after the intervention. However, as mentioned previously self-testing scores also increased significantly in EGI from pretest to posttest (Mpre = 2.74; Mpost = 3.07, $p = 0.010$). No other significant differences emerged.

Table 3 shows results of the comparisons of scores in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the Self-efficacy for learning form between groups (EGI and CG) and between times (pretest and posttest).

Repeated measures analysis of variance (Anova) was carried out to compare scores on LASSI scales and Self-efficacy for learning form between groups (EGI and CG) and between times (pre-test × posttest) to examine whether intervention program in its self-reflective format contributed to changes in participants' scores on these outcomes measures over time. Anova results revealed significant interaction effects (groups × times) in the scores of the scales of information processing (Mpre = 3.41; Mpost = 3.79, $p = 0.010$), self-testing (Mpre = 2.74; Mpost = 3.07, p = 0.021), total LASSI (Mpre = 3.09; Mpost = 3.30, $p = 0.022$) and self-efficacy for learning Form (Mpre = 55.98; Mpost = 63.64, $p = 0.006$) of EGI which increased significantly from pretest to posttest. Conversely, CG showed a statistically significant decline in scores of LASSI motivation scale, from pre to posttest (Mpre = 3.73; Mpost = 3.45; $p = 0.014$), whereas EG I did not show a statistically significant decline (or increase) in motivation. Effect sizes were medium for information processing, and motivation LASSI scales, as well as for Self-efficacy for learning form. They were small for LASSI total score and LASSI self- testing scale. No other significant differences emerged. Accordingly, data suggest that the self-reflective intervention program format may have contributed to improve both participants' information processing

TABLE 3 | Anova results for repeated measures: comparisons of scores in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the Self-efficacy for learning Form between groups (EGI and CG) and between times (pretest and posttest).

Variable*	Comparisons between groups (EG I and CG)	Effect size eta squared (η^2)	Comparisons between times (pretest and posttest)	Effect size eta squared (η^2)	Interactions groups × times	Effect size eta squared (η^2)
Total self-efficacy	$F_{(1,39)} = 0.78$; $p = 0.382$	$\eta^2 = 0.020$	$F_{(1,39)} = 0.43$; $p = 0.514$	$\eta^2 = 0.009$	$F_{(1,59)} = 8.59$; $p = 0.006$[a]	$\eta^2 = 0.179$
LASSI/ANS	$F_{(1, 38)} = 3.70$; $p = 0.062$	$\eta^2 = 0.089$	$F_{(1, 38)} = 2.34$; $p = 0.135$	$\eta^2 = 0.057$	$F_{(1, 38)} = 0.43$; $p = 0.517$	$\eta^2 = 0.011$
LASSI/ATT	$F_{(1, 38)} = 0.05$; $p = 0.827$	$\eta^2 = 0.001$	$F_{(1, 38)} = 0.00$; $p = 0.956$	$\eta^2 = 0.000$	$F_{(1, 38)} = 2.33$; $p = 0.135$	$\eta^2 = 0.058$
LASSI/CON	$F_{(1, 38)} = 0.08$; $p = 0.776$	$\eta^2 = 0.002$	$F_{(1, 38)} = 0.22$; $p = 0.641$	$\eta^2 = 0.006$	$F_{(1, 38)} = 0.12$; $p = 0.733$	$\eta^2 = 0.003$
LASSI/INP	$F_{(1, 38)} = 0.27$; $p = 0.609$	$\eta^2 = 0.007$	$F_{(1, 38)} = 2.95$; $p = 0.094$	$\eta^2 = 0.061$	$F_{(1, 38)} = 7.37$; $p = 0.010$[b]	$\eta^2 = 0.153$
LASSI/MOT	$F_{(1, 38)} = 0.00$; $p = 0.957$	$\eta^2 = 0.000$	$F_{(1, 38)} = 0.03$; $p = 0.860$	$\eta^2 = 0.001$	$F_{(1, 38)} = 6.70$; $p = 0.014$[c]	$\eta^2 = 0.150$
LASSI/SMI	$F_{(1, 38)} = 0.00$; $p = 0.989$	$\eta^2 = 0.000$	$F_{(1, 38)} = 1.24$; $p = 0.272$	$\eta^2 = 0.031$	$F_{(1, 38)} = 0.17$; $p = 0.684$	$\eta^2 = 0.004$
LASSI/SFT	$F_{(1, 38)} = 0.06$; $p = 0.805$	$\eta^2 = 0.002$	$F_{(1, 38)} = 2.62$; $p = 0.114$	$\eta^2 = 0.056$	$F_{(1, 38)} = 5.77$; $p = 0.021$[d]	$\eta^2 = 0.124$
LASSI/TST	$F_{(1, 38)} = 0.75$; $p = 0.391$	$\eta^2 = 0.019$	$F_{(1, 38)} = 0.85$; $p = 0.364$	$\eta^2 = 0.021$	$F_{(1, 38)} = 0.87$; $P = 0.357$	$\eta^2 = 0.022$
LASSI/TMT	$F_{(1, 38)} = 2.57$; $p = 0.118$	$\eta^2 = 0.063$	$F_{(1, 38)} = 0.75$; $p = 0.392$	$\eta^2 = 0.018$	$F_{(1, 38)} = 2.21$; $p = 0.146$	$\eta^2 = 0.054$
LASSI/UAR	$F_{(1, 38)} = 0.08$; $p = 0.776$	$\eta^2 = 0.002$	$F_{(1, 38)} = 0.65$; $p = 0.425$	$\eta^2 = 0.016$	$F_{(1, 38)} = 1.60$; $p = 0.214$	$\eta^2 = 0.040$
Total LASSI	$F_{(1, 38)} = 0.55$; $p = 0.462$	$\eta^2 = 0.014$	$F_{(1, 38)} = 2.34$; $p = 0.134$	$\eta^2 = 0.051$	$F_{(1, 38)} = 5.73$; $p = 0.022$[e]	$\eta^2 = 0.124$

**Variables transformed into ranks in the analysis due to the absence of Normal distribution.*

[a]Significant interaction effect between groups vs. times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for EGI.

[b]Significant interaction effect between groups vs. times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for EGI.

[c]Significant interaction effect between groups vs. times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for CG.

[d]Significant interaction effect between groups vs. times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for EGI.

[e]Significant interaction effect between groups vs. times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for EGI.

Source: authors (2020).

and self-testing skills, and their self-efficacy for learning beliefs. Moreover, it seems that the self-reflective intervention approach also has protected students from a decline in their motivation.

Table 4 shows results of the comparisons of scores in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the Self-efficacy for learning form between groups (EGII and CG) and between times (pretest and posttest).

Repeated measures analysis of variance (Anova) was carried out to compare scores on LASSI scales and Self-efficacy for learning form between groups (EGII and CG) and between times (pre-test × posttest) to evaluate whether intervention program in its theoretical format contributed to changes in participants' scores on these outcome measures over time. Significant interaction effects (groups × times) in scores of the LASSI information process scale Mpre = 3.29; Mpost = 3.74, $p = 0.027$) and of self-efficacy for learning Form emerged (Mpre = 60.13; Mpost = 68.03, $p = 0.023$). Scores increased significantly from pre to posttest in both scales for students in EGII. In contrast, CG experienced a significant decline in the LASSI motivation scale from pre to posttest (Mpre = 3.73; Mpost = 3.45, $p = 0.022$), whereas EG II did not show a statistically significant decline (or increase) in motivation. Moreover, Tukey test was used to examine whether there were differences between groups. Significant group differences emerged in the scores of LASSI self-testing scale. Higher scores in posttest were found for EGII (Mpost = 3.61, $p = 0{,}035$) when compared to CG (Mpost = 2.92). Effect sizes were medium for all scales. No other significant differences emerged. Overall, data suggest that the intervention program in its theoretical format may have had positive impacts on EGII students' information processing skills, on their self-efficacy for learning beliefs, as well as on their motivation.

In summary, students in phase 1 reported use of learning and study strategies to a certain extent and showed a moderate sense of self-efficacy for learning. Students had lower scores in anxiety, use of academic resources, self-testing, and time management. Overall, they showed a positive attitude toward their learning. Results of phase 2 showed no statistically significant group × time interactions in the comparison between EGI and EGII.

TABLE 4 | Anova results for repeated measures: comparisons of scores in the Brazilian translation of the LASSI 3rd Ed. and in the Brazilian translation of the Self-efficacy for learning Form between groups (EGII and CG) and between times (pretest and posttest).

Variable*	Comparisons between groups (EG II and CG)	Effect size eta squared (η^2)	Comparisons between times (pretest and posttest)	Effect size eta squared (η^2)	Interaction groups × times	Effect size eta squared (η^2)
Total self-efficacy	$F_{(1, 29)} = 0.02$; $p = 0.882$	$\eta^2 = 0.001$	$F_{(1, 29)} = 0.34$; $p = 0.566$	$\eta^2 = 0.010$	$F_{(1, 29)} = 5.81$; $p = 0.023$[a]	$\eta^2 = 0.165$
LASSI/ANX	$F_{(1, 29)} = 0.19$; p = 0.670	$\eta^2 = 0.006$	$F_{(1, 29)} = 0.02$; $p = 0.898$	$\eta^2 = 0.001$	$F_{(1, 29)} = 0.28$; $p = 0.603$	$\eta^2 = 0.009$
LASSI/ATT	$F_{(1, 29)} = 2.85$; p = 0.102	$\eta^2 = 0.090$	$F_{(1, 29)} = 0.89$; $p = 0.353$	$\eta^2 = 0.030$	$F_{(1, 29)} = 0.11$; $p = 0.745$	$\eta^2 = 0.004$
LASSI/CON	$F_{(1, 29)} = 0.26$; p = 0.617	$\eta^2 = 0.009$	$F_{(1, 29)} = 0.92$; $p = 0.346$	$\eta^2 = 0.030$	$F_{(1, 29)} = 0.51$; $p = 0.481$	$\eta^2 = 0.017$
LASSI/INP	$F_{(1, 29)} = 0.01$; $p = 0.906$	$\eta^2 = 0.000$	$F_{(1, 29)} = 2.74$; $p = 0.109$	$\eta^2 = 0.074$	$F_{(1, 29)} = 5.43$; $p = 0.027$[b]	$\eta^2 = 0.146$
LASSI/MOT	$F_{(1, 29)} = 0.24$; $p = 0.627$	$\eta^2 = 0.008$	$F_{(1, 29)} = 0.04$; $p = 0.853$	$\eta^2 = 0.001$	$F_{(1, 29)} = 5.85$; $p = 0.022$[c]	$\eta^2 = 0.168$
LASSI/SMI	$F_{(1, 29)} = 0.16$; $P = 0.695$	$\eta^2 = 0.005$	$F_{(1, 29)} = 0.16$; $p = 0.692$	$\eta^2 = 0.006$	$F_{(1, 29)} = 0.00$; $p = 0.997$	$\eta^2 = 0.000$
LASSI/SFT	$F_{(1, 29)} = 4.89$; $p = 0.035$[d]	$\eta^2 = 0.144$	$F_{(1, 29)} = 0.70$; $p = 0.411$	$\eta^2 = 0.021$	$F_{(1, 29)} = 3.75$; $p = 0.063$	$\eta^2 = 0.112$
LASSI/TST	$F_{(1, 29)} = 0.01$; $p = 0.932$	$\eta^2 = 0.000$	$F_{(1, 29)} = 2.27$; $p = 0.143$	$\eta^2 = 0.068$	$F_{(1, 29)} = 2.01$; $p = 0.167$	$\eta^2 = 0.060$
LASSI/TMT	$F_{(1, 29)} = 1.11$; $p = 0.300$	$\eta^2 = 0.037$	$F_{(1, 29)} = 1.10$; $p = 0.303$	$\eta^2 = 0.034$	$F_{(1, 29)} = 2.70$; $p = 0.111$	$\eta^2 = 0.082$
LASSI/UAR	$F_{(1, 29)} = 1.83$; $p = 0.186$	$\eta^2 = 0.060$	$F_{(1, 29)} = 0.10$; $p = 0.758$	$\eta^2 = 0.003$	$F_{(1, 29)} = 1.18$; $p = 0.286$	$\eta^2 = 0.039$
Total LASSI	$F_{(1, 29)} = 0.00$; $p = 0.978$	$\eta^2 = 0.000$	$F_{(1, 29)} = 0.60$; $p = 0.446$	$\eta^2 = 0.019$	$F_{(1, 29)} = 1.74$; $p = 0.198$	$\eta^2 = 0.056$

**Variables transformed into ranks in the analysis due to the absence of Normal distribution.*

[a] Significant interaction effect between groups × times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): none.

[b] Significant interaction effect between groups and times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for EGII.

[c] Significant interaction effect between groups × times: significant differences between groups (Tukey test): none; significant differences between times (Profile test by contrast): Pre≠ Post for CG.

[d] Significant differences between groups (Tukey test): CG≠ EG II in Posttest.

Source: authors (2020).

These two groups did not differ significantly in how they changed over time in the outcome measures. However, when compared with the control group, both intervention formats seemed to have positive impacts on participants' outcome measures. EGI showed statistically significant gains over the control group in five outcome measures (i.e., self-efficacy, LASSI total score, motivation, and LASSI scales of information processing and self-testing), whereas EGII showed statistically significant gains over CG in three of the outcome measures (i.e., self-efficacy, motivation, and LASSI scale of information processing).

DISCUSSION

Phase 1 of the present study was designed to identify the learning and study strategies and the self-efficacy for learning beliefs of Brazilian university students seeking a licentiate degree plan in Biological Sciences, Chemistry, Physics, and Mathematics courses of teacher education programs of a federal higher education institution in the state of Piauí.

Students reported using learning and study strategies moderately, with some strategies being more used than others. The lowest mean and median in the LASSI were for the anxiety and use of academic resource scales, followed by self-testing and time management. It seems that students in the sample do not deal very well with their anxiety as well as do not seek help in resources available at the university, as evidenced by their relatively lower scores in these scales. They seem to fear and worry about possible academic failures. In turn, this may hinder them from focusing attention on relevant thoughts and behaviors for successful accomplishment of academic tasks. Studies indicate that, during undergraduate program, students face problems not previously experienced, which can generate more anxiety and might make them less prone to seek help (Bartalo and Guimarães, 2008; Weinstein et al., 2016; Medeiros and Bittencourt, 2017). Moreover, students also reported having problems in time management and difficulty to monitor their comprehension while learning. Overall, the findings are consistent with the literature, which indicates that students enter university with gaps in many areas and lack strong and desirable strategic and self-regulatory skills to cope with the demands of higher education (Bembenutty, 2011; Boruchovitch and Ganda, 2013; Marini and Boruchovitch, 2014;

ACT, 2016; Araújo et al., 2016; Pavesi and Alliprandini, 2016; Weinstein and Acee, 2018; Biwer et al., 2020). The attitude scale, on the other hand, had the highest mean and median in the LASSI. As this scale assesses the value that students attribute to the educational institution, the importance they assign to accomplishing educational goals successfully, the results showed that students seem to value coursework and academic performance as a means to attain future professional success. This result is positive and is similar to those found by Bartalo and Guimarães (2008) and Endo et al. (2017); however, it differs from the results of Iqbal et al. (2010), who found that Pakistani university students did not show positive attitudes toward the university.

Regarding self-efficacy for learning, students showed a moderate sense of self-efficacy for learning. Such result differed from those from studies that found a higher sense of self-efficacy among university students (Jakešováa et al., 2015; Erb and Drysdale, 2017). As having positive attitudes toward learning and adaptive beliefs about one's own ability to perform academic tasks successfully are factors that influence academic achievement and future professional life, a higher sense of efficacy for learning would be desirable among students in the sample (Bandura, 1997; Pajares and Olaz, 2008).

Overall, data collected in phase 1 of the present study showed the need for strengthening strategic and self-regulatory skills and self-efficacy for learning beliefs of higher education students in teacher education programs. Because the students in this study did not score high in the measures employed, it was clear that there was room and need for improvement. Thus, results from phase 1 of the study served as a basis for the design of a self-regulated learning intervention program, in two formats (theoretical with self-reflective activities and theoretical only) examined in phase 2. EGI received theoretical content and self-reflective activities and EGII received theoretical content only. The inclusion of self-reflective activities was expected to facilitate internalization of self-regulated learning approaches and lead to stronger gains in self-reported learning and study strategies and self-efficacy over time.

Accordingly, the first hypothesis was that students who participated in intervention program with self-reflection (EGI) would show the highest increase in their self-reported use of learning and study strategies and in their self-efficacy for learning beliefs from pretest to posttest compared with students who received the intervention in its traditional format, without self-reflection activities (EGII), and with those who did not participate in either intervention (CG). Although no statistically significant group × time interaction effects were observed when comparing EGI and EGII, when comparing each intervention with CG, EGI showed statistically significant effects in more outcome measures than EGII. Therefore, there was partial support that EGI produced greater benefits to students than EGII. More specifically in terms of interaction effects, EGI showed higher increases in total LASSI scores and self-testing compared with control, whereas EGII showed no improvements over the control group in these areas. Prompting students to self-reflect about their strategic and self-regulated learning may have helped those in EGI obtain these additional benefits. Both EGI and EGII outperformed CG over time in self-efficacy, motivation, and information processing. This provided support for our hypothesis that EG II would outperform CG, but not as strongly as EGI would outperform CG. This evidence could suggest that providing instruction on SRL with or without self-reflective prompts can help to improve students' self-efficacy and information processing over time and protect from motivational declines, as we observed decreases in the LASSI motivation scale in CG, but not in EGI and EGII.

Considering what LASSI scales measure, it seems that EGI students improved their ability to monitor their learning, to create links between prior knowledge and what they are trying to learn, and to use a variety of learning and study strategies. Furthermore, as students' self-efficacy for learning beliefs also improved in EGI, it seems that students became more confident about their capability to engage in successful learning. This increase in student confidence in their ability to learn is also encouraging, because having strong self-efficacy for learning beliefs is essential for setting goals, effort management, persistence, and resilience in the face of difficulties and risk of failure (Bandura, 1997; Pajares and Olaz, 2008). Such changes may be attributed to the format of the intervention that made use of self-reflective activities, which might have made students more aware of the importance of using cognitive, metacognitive, motivational, and affective regulation strategies to empower their learning. These results are in line with the literature that supports the importance of self-reflection as a means of promoting and strengthening strategic and self-regulatory skills. Studies show that using self-reflective activities when teaching theoretical information about self-regulated learning can enhance students' self-regulated skills (Dembo, 2001; Boruchovitch and Ganda, 2013; Kramarski and Kohen, 2016; Ganda and Boruchovitch, 2018; Michalsky and Schechter, 2018).

There were also significant interaction effects between EGII and CG. EGII students reported significantly more use of information processing strategies, as well as higher scores in self-efficacy for learning form in posttest when compared with CG students. This result confirms the second hypothesis that students in EGII, in the posttest, would show higher scores, in the LASSI and in the Self-efficacy for learning scales when compared with CG. When we consider what the LASSI information processing scale measures, it seems that participants in EGII became more aware of the importance of using imagery and verbal elaboration strategies. These skills are undoubtedly important for good academic performance (Zimmerman and Schunk, 2008; Weinstein et al., 2016; Schunk and Greene, 2018), and it seems somehow that they could have been fostered by the intervention (Bartalo and Guimarães, 2008; Ganda and Boruchovitch, 2018). Taken together, the gains found in EGII from pretest to posttest in comparison with both EGI and CG may suggest the importance of a traditional course on self-regulated learning, since it provided participants of EGII with theoretical knowledge about learning strategies, in addition to other important self-regulated learning-related themes. Fabriz et al. (2013) argue that students' participation in a theoretical course on self-regulation of learning can also contribute to increase their learning and study strategies. In consonance, results of EGII are in line with the literature and can also be considered positive.

CG students showed no gains either in LASSI scales or in their self-efficacy for learning beliefs. Nonetheless, it was interesting to note that there were significant interaction effects between EGI, EGII, and CG in the LASSI motivation scale. CG showed a statistically significant decrease in motivation from pretest to posttest in comparison with students in both EGI and EGII. These data were important, since they might have expressed the moment that this group was experiencing in their university, characterized by the lack of teachers for teaching important courses for their education. As no treatment was applied to CG, this situation seems to have also contributed to explain the decreased motivation in this group and the students' reports of lower persistence to achieve academic goals. Conversely, it is possible that the EGI and EGII interventions may have protected the students from this decrease. Lack of academic achievement motivation is itself a major problem in the classroom. Theorists argue that a motivation and maladaptive forms of motivation may negatively influence the learning process (Wolters and Benzon, 2013; Bzuneck and Boruchovitch, 2016; Weinstein et al., 2016; Kim et al., 2018).

Although the changes were not as many as expected, the results of this study, on the one hand, reinforce the importance of self-reflective activities for strengthening strategic and self-regulatory skills, since EGI students showed gains in more LASSI scales and in their efficacy beliefs, when compared with both EGII and CG (Boruchovitch and Ganda, 2013; Andrzejewski et al., 2016; Ganda and Boruchovitch, 2018; Michalsky and Schechter, 2018). On the other hand, as EGII students also improved their scores in one LASSI scale and in the self-efficacy for learning form, compared with CG, data also confirm the importance of students' participation in a theoretical course on self-regulation of learning as way of not only providing them with theoretical knowledge about this framework but also helping them improve their learning and study strategies (Fabriz et al., 2013; Ganda and Boruchovitch, 2018). Furthermore, although no self-reflective activities were assigned to EGII students, it is possible that they engaged in self-reflection about their learning only by receiving theoretical information about the self-regulated learning framework. As described in Ganda and Boruchovitch (2018), a course on self-regulated learning is self-reflective by nature. The amount of spontaneous self-reflection in which students could have engaged is a variable that is difficult to control and might have worked as contributor for such finding. The impact of theoretical knowledge about self-regulated learning on learning behavior should be further investigated.

In summary, results of phase 2 of the present study suggest that both self-regulated learning intervention formats (theoretical/reflective intervention and theoretical intervention only) may have had a positive impact on participants of this study to a certain extent. Consistently with the literature, they also show the potential benefits of the theoretical/reflective intervention format for increasing strategic and self-regulatory skills, when compared with a theoretical course. In addition, as there is a need for deepening knowledge about cultural issues in self-regulation of learning (Schunk and Greene, 2018), we believe that data from this study could also have contributed to describe what are the learning and study strategies and the self-efficacy for learning beliefs of Brazilian university students who aspire to be teachers, a still underrepresented population in self-regulated learning research.

Despite the contributions, there were several limitations and possible confounding variables in this research, which could have affected the results rather than the intervention program. Among them, the following stand out: the sample was composed of students from different licentiate program areas because they were those who had free time to participate in the research and could attend a self-regulated learning program. Moreover, the institution provides only one licentiate course per area per year. Although classes were randomly assigned to treatment conditions, students were not comparable in the LASSI self-testing scale in pretest. In addition, differences in background variables not reflected in pretest measures could also have interfered with posttest results. The sample size of the 3 groups was under 30 students. The study relied on quantitative self-reported measures only, which are subject to social desirability. Additionally, the study employed the same measures in pretest and posttest. Testing effects could have occurred as well. The institution's Internet connectivity problems during data collection made some students respond to paper and pencils versions of the scales, while other answered them online. Furthermore, although the instruments employed in this study had acceptable internal consistency values, both scales have not been validated for use in Brazil yet. Because the first author taught the intervention course in the two formats without the presence of an observer, we are unable to assure the fidelity of implementation of the different program formats. The content of the intervention was not equally distributed. There was heavy emphasis on learning strategies over motivational regulation and emotional regulation.

Future investigations should overcome the limitations of the present study. Further research should also invest efforts in increasing the knowledge about variables that impact the students' engagement in strategic and self-regulated behavior, before planning interventions. As the duration of the intervention program in this study was very short, some benefits could not have been well-assessed using short-term measures (Jacob et al., 2019). Follow-up studies with EGI, EGII, and CG students would be interesting to examine the long-term impact of the program in their academic achievement and to evaluate the dropout rates among these groups.

We hope the intervention program based on self-reflective activities designed for this study can be further refined and become a regular course on self-regulation for students who aspire to be teachers. A self-regulation course can, in turn, help these students improve in a dual perspective: as a student and as a future teacher. In consonance, as practical implications, this study highlights the importance of creating opportunities for students, especially those who aspire to be teachers, to get in touch and become aware of how they learn. Self-regulated learning and strategic learning models can be useful to guide educational psychologist teachers to achieve this goal. Moreover, the findings also pointed out that the students' awareness about their learning and study strategies as well as about the psychological variables that interfere with their learning can be increased either using self-reflective activities or by teaching theoretical content about SRL. Models combining instruction

with both self-reflective and theoretical activities should also be tested in more long-term longitudinal research designs. Finally, due to their relevance, it is expected that self-regulated learning courses become part of the official curricula in Teacher Education programs in Brazil, so more students and future teachers can benefit and learn in a strategic, self-regulated manner and have their self-efficacy for learning beliefs strengthened.

CONCLUSIONS

Fostering strategic and self-regulated learning in preservice teachers has the potential to improve their effectiveness as students and as educators. Phase 1 of this study showed that preservice teachers in Piaui, Brazil self-reported fairly moderate levels of strategic and self-regulated learning skills, suggesting potential for improvement through intervention. Phase 2 of this study showed that teaching students about strategic and self-regulated learning, and prompting them to self-reflect about its applicability to their own studying and teaching, helped them to improve their self-reported use of strategic and self-regulated learning skills and self-efficacy to build those skills. Future research should continue to examine the effectiveness of teaching strategic and self-regulated learning within teacher education programs and the role of embedding self-reflective activities within these interventions on longitudinal outcomes that track students into the workplace.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The project was first submitted to and approved by the Research Ethics Committee of the Faculty of Education of a Brazilian public university (Protocol CAAE: 02209218.6.0000.8142), in compliance with the current standards of the National Health Council, Resolution no. 510/2016, which establishes the ethical issues of research conducted with human beings in Brazil. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

This paper is part of a doctoral dissertation research of ÂA carried out under the supervision of EB. It is also part of a larger research project carried out by EB in collaboration with ÂA, TA, and NG. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

EB thanks the Brazilian National Council for Scientific and Technological Development – CNPq for the financial support (Process 403620/2016-3). The authors also thank Espaço da Escrita – Coordenadoria Geral da Universidade - UNICAMP - for the language services provided.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2020.571150/full#supplementary-material

REFERENCES

ACT (2016). *The Condition of College and Career Readiness 2016*. Available online at: www.act.org/content/dam/act/unsecured/documents/CCCR_National_2016.pdf (accessed March 30, 2020).

Andrzejewski, C. E., Davis, H. A., Bruening, P. S., and Poirier, R. R. (2016). Can a self-regulated strategy intervention close the achievement gap? Exploring a classroom-based intervention in 9th grade earth science. *Learn. Individ. Differ.* 49, 85–99. doi: 10.1016/j.lindif.2016.05.013

Araújo, A., Santos, A. A., Noronha, A. P., Zanon, C., Ferreira, J. A., Casanova, J. R., et al. (2016). Dificuldades antecipadas de adaptação ao ensino superior: um estudo com estudantes do primeiro ano. *Rev. Estudos Investig. Educ.* 3, 102–111. doi: 10.17979/reipe.2016.3.2.1846

Bakeman, R. (2005). Recommended effect size statistics for repetead measures designs. *Behav. Res. Methods* 37, 379–384. doi: 10.3758/BF03192707

Balsas, M., and Boruchovitch, E. (2015). A autoeficácia na formação de professores. Paper presented at *Congresso de Iniciação Científica* (São Paulo).

Bandura, A. (1978). The self-system in reciprocal determinism. *Am. Psychol.* 33, 344–358. doi: 10.1037/0003-066X.33.4.344

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NY: Prentice Hall.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: W.H. Freeman and Company.

Bartalo, L., and Guimarães, S. (2008). Estratégias de estudo e aprendizagem de alunos universitários: um estudo exploratório. *Informação Informação* 13, 1–14. doi: 10.5433/1981-8920.2008v13n2p1

Bembenutty, H. (2011). New directions for self-regulation of learning in post-secondary education. *New Direct. Teach. Learn.* 126, 117–124. doi: 10.1002/tl.450

Biwer, F., Egbrink, M., Aalten, P., and Bruin, A. (2020). Fostering effective learning strategies in Higher Education-a mixed-methods study. *J. Appl. Res. Mem. Cogn.* 9, 186–203. doi: 10.1016/j.jarmac.2020.03.004

Boruchovitch, E., and Ganda, D. R. (2010). *Escala de autoeficácia para aprendizagem. Translation and adaptation into portuguese of the Barry Zimmerman and Anastacia Kitsantas (2005) Self-efficacy for Learning Form* (Unpublished manuscript). State University of Campinas, Campinas, Brazil.

Boruchovitch, E., and Ganda, D. R. (2013). Fostering self-regulated skills in an educational psychology course for Brazilian preservice teachers. *J. Cogn. Educ. Psychol.* 12, 157–177. doi: 10.1891/1945-8959.12.2.157

Boruchovitch, E., Ganda, D. R., Tanikawa, H. M., Sordi, L., Machado, A. C., and Suehiro, A. C. D. (2015). "Autoeficácia para aprendizagem autorregulada de estudantes universitários brasileiros de cursos de formação de professores," in *XIII International Galego-Português Congress of Psicopedagogia* (Coruña: University of Coruña), 973–974.

Boruchovitch, E., Góes, N. M., Felicori, C., and Acee, T. W. (2019). Translation and adaptation of the Learning and Study Strategies Inventory - LASSI 3rd Edition for use in Brazil: methodological considerations. *Educ. Anál.* 4, 7–20. doi: 10.5433/1984-7939.2019v4n1p7

Bzuneck, J. A. (2009). "As crenças de autoeficácia e o seu papel na motivação do aluno," in *A Motivação do Aluno: Contribuições da Psicologia Contemporânea*, eds E. Boruchovitch and J. A. Bzuneck (Petrópolis: Vozes), 116–133.

Bzuneck, J. A., and Boruchovitch, E. (2016). Motivação e autorregulação da motivação no contexto educativo. *Psicol. Ensino Formação* 7, 73–84. doi: 10.21826/2179-58002016727584

Castro, P. A., Souza, T. S., and Sá, S. (2019). Evasão no ensino superior: Mapeamento de cursos de licenciaturas da Universidade Federal de Goiás. *Rev. EDaPECI* 18, 45–60. doi: 10.29276/redapeci.2018.18.39923.45-60

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences, 2nd Edn*. Hillsdale, NJ: Erlbaum.

Dembo, M. (2001). Learning to teach is not enough: Future teachers also need to learn to learn. *Teach. Educ. Q.* 28, 23–35.

Endo, M. M. C., Miguel, F. K., and Kiener, K. (2017). Estratégias de aprendizagem de estudantes de psicologia: um estudo exploratório. *Quaderns Psicol.* 19, 73–87. doi: 10.5565/rev/qpsicologia.1377

Erb, S., and Drysdale, M. (2017). Learning attributes, academic self-efficacy and sense of belonging amongst mature students at a Canadian university. *Stud. Educ. Adults* 49, 62–74. doi: 10.1080/02660830.2017.1283754

Fabriz, S., Ewijk, A. D., Poarch, G., and Buttner, G. (2013). Fostering self-monitoring of university students by means of a standardized learning journal a longitudinal study with process analyses. *Eur. J. Psychol. Educ.* 29, 239–255. doi: 10.1007/s10212-013-0196-z

Ganda,. D. R., and Boruchovitch, E. (2018). Promoting self- regulated learning of Brazilian preservice student teachers: results of an intervention program. *Front. Educ.* 3, 1–12. doi: 10.3389/feduc.2018.00005

Habibi, K. H., and Yanti, F. A. (2017). Exploration of teaching skills of preservice high school teachers' through self-regulated learning based on learning style. *Int. J. Environ. Sci. Educ.* 12, 339–347. doi: 10.12973/ijse.2017.01231

Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP) (2019). *Censo da Educação Superior 2018: Notas Estatísticas.* Brasília.

Iqbal, H. M., Sohail, S., and Shahzad, S. (2010). Learning and study strategies used by university students in Pakistan. *Procedia Soc. Behav. Sci.* 2, 4717–4721. doi: 10.1016/j.sbspro.2010.03.756

Jacob, R. T., Doolittle, F., Kemple, J., and Somers, M. A. (2019). A framework from learning from null results. *Educ. Res.* 48, 580–599. doi: 10.3102/0013189X19891955

Jakešováa, J., Kalenda, J., and Gavora, P. (2015). Self-regulated and academic self-efficacy of Czech university students. *Procedia Soc. Behav. Sci.* 174, 1117–1123. doi: 10.1016/j.sbspro.2015.01.803

Kim, Y., Brady, A., and Wolters, C. (2018). Development and validation of the brief regulation of motivation scale. *Learn. Individ. Differ.* 67, 259–265. doi: 10.1016/j.lindif.2017.12.010

Kramarski, B., and Kohen, Z. (2016). Promoting preservice teachers' dual self-regulation roles as learners and as teachers: effects of generic vs. specific prompts. *Metacogn. Learn.* 12, 157–191. doi: 10.1007/s11409-016-9164-8

Lawson, M., Vosniadou, S., Deur, P., Wyra, M., and Jaffries, D. (2019). Teachers' and students' belief systems about the self-regulation of learning. *Educ. Psychol Rev.* 31, 223–251. doi: 10.1007/s10648-018-9453-7

Marini, J., and Boruchovitch, E. (2014). Autorregulação da Aprendizagem em Estudantes de Pedagogia. *Paidéia* 24, 323–330. doi: 10.1590/1982-43272459201406

Medeiros, P. P., and Bittencourt, F. O. (2017). Fatores associados à ansiedade em estudantes de uma faculdade particular. Id on Line. *Rev. Multidiscipl. Psicol.* 10, 43–55. doi: 10.14295/idonline.v10i33.594

Michalsky, T., and Schechter, C. (2018). Teachers' self-regulated learning lesson design: integrating learning from problems and successes. *Teach. Educ.* 53, 101–123. doi: 10.1080/08878730.2017.1399187

Middleton, M., Abrams, E., and Seaman, J. (2011). Resistance and disidentification in reflective practice with preservice teaching interns. *New Direct. Teach. Learn.* 126, 67–75. doi: 10.1002/tl.445

Moos, D., and Ringdal, A. (2012). Self-regulated in classroom: a literature review on the teacher's role. *Educ. Res. Int.* 2012, 1–15. doi: 10.1155/2012/423284

Pajares, F., and Olaz, F. (2008). "Teoria social cognitiva e autoeficácia: Uma visão geral," in Teoria cognitiva: conceitos básicos (Porto Alegre: Artmed), 97–114.

Pavesi, M. A., and Alliprandini, P. M. Z. (2016). Análise da aprendizagem autorregulada de alunos de cursos a distância em função das áreas de conhecimento. *Educ. Formação Tecnol.* 9, 3–15.

Pérez, A., Marín, V., and Tur, G. (2018). Information management tools for the development of self-regulated learning skills in pre-service teacher education. *@tic Rev. Innov. Educ.* 21, 31–39. doi: 10.7203/attic.21.12134

Pew Research Center (2016). *The State of American Jobs: How the Shifting Economic Landscape Is Reshaping Work and Society and Affecting the Way People Think About the Skills and Training They Need to Get Ahead*. Available online at: www. pewsocialtrends.org/2016/10/06/1-changers-in-the-american-workplace (accessed May 22, 2020).

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educ. Psychol. Rev.*16, 385–407. doi: 10.1007/s10648-004-0006-x

Poitras, E. G., Doleck, T., Huang, L., Li, S., and Lajoie, S. P. (2017). Advancing teacher technology education using open-ended learning environments as research and training platforms. *Aust. J. Educ. Technol.* 33, 32–45. doi: 10.14742/ajet.3498

Prieto, G., and Muñiz, J. (2000). Un modelo para evaluar la calidad de los tests utilizados em España. *Papeles Psicól.* 77, 65–72.

Schunk, D. H., and Greene, J. A. (2018). "Historical, comtemporary and future perspectives on self-regulated learning and performance," in *Handbook of Self-Regulation of Learning and Performance*, eds D. H. Schunk and B. J. Zimmerman (New York, NY: Routledge), 1–15.

Schunk, D. H., and Zimmerman, B. J. (2008). *Motivation and Self-Regulation Learning: Theory, Research, and Applications.* Lawrence Erlbaum Associates.

Silva, K. N., and Figueiredo, M. C. (2018). Curso de licenciatura em química: motivações para a evasão discente. *ACTIO Docência Ciências* 3, 237–254. doi: 10.3895/actio.v3n2.7441

Simmons, C. A., and Lehman, P. (2015). *Tools for Strengths-Based Assessment and Evaluation.* New York, NY: Springer Publishing Company.

Vrieling, E., Stijnen, S., and Bastiaens, T. (2017). Successful learning: balancing self-regulation with instructional planning. *Teach. Higher Educ.* 23, 685–700. doi: 10.1080/13562517.2017.1414784

Weinstein, C. E. (1994). "Strategic learning/strategic teaching: flip sides of a coin," in *Student Motivation, Cognition, and Learning: Essays in Honor of Wilbert J. McKeachie*, eds P. R. Pintrich, D. R. Brown, and C. E. Weinstein (Hillsdale, NJ: Erlbaum), 257–273.

Weinstein, C. E., and Acee, T. W. (2018). "Study and learning strategies," in *Handbook of College Reading and Study Strategy Research,* Vol. 3, eds R. F. Flippo and T. W. Bean (New York, NY: Routledge), 227–238.

Weinstein, C. E., Palmer, D., and Acee, T. W. (2016). *LASSI - Learning and Study Strategies Inventory, 3rd Edn.* Clearwater, FL: H&H Publishing Company, Inc.

Wolters, C., and Benzon, M. (2013). Assessing and predicting college students use of strategies for the self-regulation of motivation. *J. Exp. Educ.* 81, 199–221. doi: 10.1080/00220973.2012.699901

Yandari, I. A., Nindiasari, H., Khaerunnisa, E., Pamungkas, A. S., and Nurjanah. (2018). "Self-regulated learning in designing explorative learning tools among mathematics pre-service teachers through explorative module," in *SHS Web of Conferences (Bali)*, 42, 1–6.

Zimmerman, B. J. (2000). "Attaining self-regulation: A social cognitive perspective," in *Handbook of Self-Regulation* (San Diego, CA: Academic Press), 13–39. doi: 10.1016/B978-012109890-2/50031-7

Zimmerman, B. J. (2002). Becoming a self-regulated learner: an overview. *Theory Pract.* 41, 64–70. doi: 10.1207/s15430421tip4102_2

Zimmerman, B. J. (2013). From cognitive modeling to self- regulation: a social cognitive career path. *J. Educ. Psychol.* 48, 135–147. doi: 10.1080/00461520.2013.794676

Zimmerman, B. J., and Kitsantas, A. (2005). "The hidden dimension of personal competence: self-regulated learning and practice," in *Handbook of Competence and Motivation*, eds A. J. Elliot and C. S. Dweck (New York, NY: Guilford Press), 204–222.

Zimmerman, B. J., and Kitsantas, A. (2007). Reliability and validity of self-efficacy for learning Form (SELF) scores of college students. *J. Psychol.* 215, 157–163. doi: 10.1027/0044-3409.215.3.157

Zimmerman, B. J., and Schunk, D. H. (2008). "Motivation: an essential dimension of self-regulated," in *Motivation and Self-Regulated Learning: Theory,*

Research and Applications, eds D. H. Schunk and B. J. Zimmerman (MPG Books Group).

Zimmerman, B. J., and Schunk, D. H. (2011). "Self-regulated and performance: an introduction and an overview," in *Handbook of Self-Regulation of Learning and Performance*, eds D. H. Schunk and B. J. Zimmerman (New York, NY: Routledge; Taylor Francis Group), 1–12.

Conflict of Interest: TA is a co-author on the Learning and Study Strategies Inventory 3rd Edition and has a financial interest in this commercial product because he receives royalties on its sales. However, the Brazilian translation of the LASSI 3rd Edition used in this research project is not a commercial product, it has never been bought or sold, and the third author has, thus, received no royalties or any other kind of financial payment in connection with this research project. Nevertheless, there is potential for TA's connection with the LASSI 3rd Edition to be constructed as a conflict of interest and is therefore being reported.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.