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The impact of a university teacher training program promoting self-regulated learning on teacher knowledge, self-efficacy, and practices

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The aim of this study was to assess the impact of a teaching training program on teachers' knowledge, self-efficacy, and teaching practices. A 21-h program was developed to enhance self-regulated learning in higher education students, focusing on planning, teaching, and assessment practices. The research design employed a quasi-experimental approach, utilizing pre- and post-tests with an experimental group and a control group. The experimental group consisted of 32 teachers, while the control group comprised 28 teachers. The results obtained from a Linear Multi-level Model analysis revealed the following findings: (1) the training program did not have a significant impact on the participants' knowledge; (2) there was a significant positive effect on overall teacher self-efficacy, with the Health Sciences and Psychology faculties demonstrating higher levels of self-efficacy compared to other faculties; and (3) the training program significantly improved teaching practices for the promotion of self-regulated learning, with no significant differences observed between faculties.

KEYWORDS

self-regulated learning, teacher training, self-efficacy, teaching practices, higher education

1. Introduction

Traditionally, one of the most valued characteristics of university professors has been their expertise in specific disciplines. However, the need to enhance their pedagogical skills, such as planning, teaching, and assessment practices, has become evident due to the challenges higher education has encountered in recent years. There is also evidence that supports the fact that training programs improve teachers' pedagogical skills (Ödalen et al., 2019). Consequently, university teacher training has increased, along with discussions about the most effective methods for implementing it, such as content, learning outcome, and instructional strategies. This research builds on recommendations for empirical evidence regarding the impact of teacher training (Gibbs and Coffey, 2000, 2004; Postareff et al., 2007; Devlin, 2008; Stes et al., 2010a). However, some studies in this field do not evaluate their results and changes in teachers' variables using questionnaires with minimum psychometric standards (Gibbs and Coffey, 2004). Moreover, they typically use limited tools, such as satisfaction questionnaires (Stes et al., 2010b;

Chalmers and Gardiner, 2015). The majority of articles published in this field are descriptive in nature, showing the design of interventions and their objectives, without advancing the assessment of their impact on teaching and learning process variables. There is a need to create research lines that not only present the design and implementation of these training interventions but also empirically measure the changes in beliefs and behavior of university teachers to demonstrate their efficacy (Gibbs and Coffey, 2000).

Although research is scarce, it has been shown that these types of programs can influence teaching practices (Gibbs and Coffey, 2004), teaching approaches (Gibbs and Coffey, 2004; Postareff et al., 2007, 2008; Stes et al., 2010a), and teachers' self-efficacy (Postareff et al., 2007, 2008; Stes et al., 2010a). The present study showcases the results of a teacher training program aimed at promoting self-regulated learning among university students and improving the performance of participating teachers. We chose to focus on self-regulated learning since it holds significant relevance in the study of learning, especially in higher education (Cassidy, 2011; Elvira-Valdés and Pujol, 2012; Panadero, 2017). This ability allows students to plan, monitor, and evaluate their own learning processes, setting personal goals that they strive to achieve. Moreover, students who possess self-regulated skills attain better academic results, display commitment to their tasks, and adjust more effectively to university life (Pintrich, 2000; Zimmerman, 2002; Schunk, 2005; Cazan, 2012; Panadero and Alonso-Tapia, 2014).

Research in this field has progressed from merely describing the characteristics of self-regulated learners to designing, implementing, and evaluating interventions that aim to teach this skill. However, there is a scarcity of studies that focus on the role of teachers in fostering the development of self-regulation through classroom practices and instruction (Cerezo et al., 2010; Kistner et al., 2010; Cazan, 2013).

In the present study, our aim is to enhance students' capacity for self-regulated learning by designing, implementing, and evaluating a teacher training program focused on promoting self-regulation practices. We expect this program to have an impact on three teacher variables: knowledge about self-regulation, self-efficacy, and practices that promote this ability. Our research question seeks to answer whether a teacher training program can influence teachers' knowledge, self-efficacy, and practices related to promoting self-regulated learning.

1.1. Teacher variables intervened in this study

1.1.1. Teacher knowledge

One of the research areas that has emerged in recent decades regarding professional teaching knowledge is "teacher thinking." The primary interest has been to understand the reasoning processes that occur in teachers' minds during their professional activities (Pajares, 1992; Solar and Díaz, 2009; Serrano, 2010). Within these processes, there exists teacher knowledge, which encompasses information about objective facts acquired over time through formal instruction and experience (Pajares, 1992). It is categorized into three types: pedagogical knowledge, content knowledge, and pedagogical content knowledge. Pedagogical knowledge involves understanding how to teach, and content knowledge refers to mastery of the subject being taught, while pedagogical content knowledge involves knowledge of teaching strategies specific to a particular discipline. Knowledge can be enhanced through instruction and teaching (Dignath-van Ewijk and Van der Werf, 2012).

Studies that examine the concept of knowledge related to self-regulated learning are limited. One such study aimed to investigate teachers' knowledge in relation to the promotion of self-regulated learning (Dignath-van Ewijk and Van der Werf, 2012). The findings revealed that teachers are familiar with the concept of self-regulated learning but struggle to apply it effectively in the classroom.

Another study conducted by Javornik and Ivanus (2010) sought to compare teachers' perceptions of self-regulated learning based on their level of professional development. They used Fuller (1969) model, which proposes that teacher professional development typically progresses through three stages: 1. Concerns about personal performance, 2. Concerns about the tasks to be accomplished, and 3. Concerns about the impact of their instructional practices on student learning. The results demonstrated that teachers at a higher level of professional development, specifically those who were concerned about the impact of their actions on student learning, held conceptions of learning that were oriented toward self-regulation. These teachers viewed their students' learning as a self-regulated process. Interestingly, similar results were observed among teachers at an early stage of professional development, where concerns about personal performance were prominent. In contrast, teachers in the intermediate stage, focused on task-related concerns, believed that their students required external stimulation and regulation to facilitate the learning process.

1.1.2. Teacher self-efficacy

The teacher's role has evolved from being a traditional transmitter of knowledge to becoming an organizer and guide of learning. They now serve as facilitators who structure situations, motivate students, guide learning processes, provide essential information, and assess performance. In this context, teachers are expected to act as guides and supervisors of student development (Rodríguez et al., 2009). Consequently, their effectiveness in teaching activities is influenced by their self-confidence and feelings of competence. Therefore, training teachers to enhance their self-efficacy can improve students' abilities and subsequently enhance their academic performance (Postareff et al., 2007).

Self-efficacy is defined as an individual's belief in their ability to perform adequately, utilizing their skills and resources in a given situation (Bandura, 2000). Teacher self-efficacy specifically refers to teachers' beliefs in their ability to perform their academic tasks effectively (Tschannen-Moran and Woolfolk, 2001). Teachers with high levels of self-efficacy are more likely to engage in a diverse and effective range of teaching practices compared to those with lower levels of self-efficacy.

Much of the research on teacher self-efficacy has been conducted in the context of primary and secondary schools (Postareff et al., 2007, 2008). However, in the higher education setting, a noteworthy study was conducted in Australia. Its objective was to explore the motivation and self-efficacy related to teaching and research activities among 110 academics from various positions and faculties. The study found that self-efficacy is a relatively stable variable among academics, with no significant differences based on gender. Both men and women in academia exhibited similar levels of teacher self-efficacy (Bailey, 1999).

1.1.3. Practices to promote self-regulated learning

The teacher plays a crucial role as an organizer and facilitator of learning, promoting collaboration and peer support among students. They guide and instruct learners individually or in groups, equipping them with various strategies that they can apply independently. The teacher's practices have a direct impact on students' ability to self-regulate their learning (Postholm, 2010). Research provides evidence that the instructional methods employed by teachers are linked to students' self-regulation (Cazan, 2013).

The existing literature highlights planning, teaching, and assessment practices that significantly influence self-regulated learning. These practices served as the foundation for designing the intervention conducted in this study, aiming to train teachers to implement them in their classrooms with their own students.

Regarding planning practices, they involved creating a learning-driven environment (Daura, 2010), including ongoing evaluation of learning outcomes (Daura, 2010; Valenzuela and Pérez, 2013) and fostering teacher–student discussions on planning strategies using a syllabus or class schedule (Valenzuela and Pérez, 2013).

In terms of teaching practices, they encompassed direct and explicit instruction on study strategies and critical thinking skills (Perry et al., 2008; Valenzuela and Pérez, 2013), providing explicit verbal and written reinforcement of self-regulation practices (Perry et al., 2008), utilizing think-aloud protocols (Pintrich et al., 2000; Torrano and González, 2004), implementing diaries, logbooks, or study portfolios (Daura, 2010; Inan and Yüksel, 2010), and employing process and metacognitive questions (Perry et al., 2008).

Regarding assessment practices, they involved using authentic tasks (Ling Lau, 2013), employing formative assessment (Clark, 2012), assessing generic competencies with guidelines and rubrics (Villarroel and Bruna, 2014), encouraging self-assessment (Paris and Paris, 2001), and providing feedback on learning (Hattie and Timperley, 2007).

2. Methods

2.1. Design

The study employed a quasi-experimental design with pre- and post-tests and control and experimental groups (Campbell and Stanley, 1963; Montero and León, 2007). A training program was designed to promote self-regulated learning practices for university teachers, serving as the independent variable. The impact of the program was assessed through three dependent variables: knowledge, self-efficacy, and practices related to promoting self-regulated learning.

Two groups of teachers were considered: the experimental group and the control group. The participants were not randomly assigned as participation in the program was voluntary through an open invitation. Therefore, these groups were non-equivalent, although equivalence was maintained within the experimental group through consistent application conditions. The experimental group comprised teachers who attended and followed the program instructions, while the control group consisted of teachers who were also invited but did not attend the program. The control group was formed by matching each trained teacher with a counterpart who taught the same subject in a different section or a subject with similar characteristics at a higher or lower level.

This study adhered to the assumptions of quasi-experimental designs outlined by Campbell and Stanley, including:

1. Involvement of pre-existing or naturally occurring groups that are not randomly assigned.
2. Assignment of treatment to the experimental group.
3. Ensuring similarity between the groups.
4. Consideration of external validity.

The training course spanned 21 h in total and took place at the beginning of the semester, allowing the participants to apply the strategies learned in their classrooms. It was facilitated by the Teaching Development Center of the participating university, which provided formal certifications. The course was delivered in eight sessions, with a frequency of one session per week, and each session lasted 2 h. Post-tests were administered at the end of the semester to assess the outcomes.

2.2. Participants

A total of 60 teachers from a private Chilean university participated in the study. The experimental group consisted of 25 women (78.1%) and 7 men (27.9%), with an average age of 41.8 years and an average of 10.4 years of teaching experience. The control group included 17 women (60.7%) and 11 men (39.3%), with an average age of 42 years and an average of 12 years of teaching experience. These teachers represented six faculties: Health Sciences, Law, Psychology, Education, Economy and Business, and Engineering.

The sample size was determined using G-Power software. The recommended sample size was 54 teachers, considering a small effect size (0.25), two measures (pre and post), a confidence level of $\alpha = 0.05$, and a power of 0.8. To account for possible sample attrition, a higher number of participants was included. The choice of a small effect size was based on the fact that effect sizes reported in the literature are typically for interventions targeting elementary and secondary students directly. Meta-analyses of such interventions have shown a moderate-to-large effect size on average (Dignath-van Ewijk and Buttner, 2008; De Boer et al., 2012).

2.3. Instruments

The selection of instruments was based on their widespread use in studies worldwide and their demonstrated satisfactory psychometric properties.

2.3.1. Questionnaire of knowledge about self-regulated learning

This questionnaire, developed by Dignath-Van Ewijk and Van der Werf (2012) in the Netherlands, consists of eight items. The items are scored on a Likert scale ranging from 1 to 5 and are designed to assess teachers' knowledge of effective instructional strategies, which directly promote self-regulated learning.

2.3.2. Teacher self-efficacy scale

This scale, created by Tschannen-Moran and Woolfolk (2001) in the United States, was utilized in its abbreviated version. It comprises 12 items, scored on a Likert scale ranging from 1 to 9. The scale is divided into three sub-dimensions: (a) Efficacy for classroom management, (b) Efficacy in student engagement, and (c) Efficacy for instructional strategies.

2.3.3. Questionnaire of practices for the promotion of self-regulated learning

The Inventory of Processes of Self-regulation of Learning, initially developed by Rosário et al. (2007) in Spain, was adapted and validated for use with teachers. The questionnaire consists of 12 items, which are scored on a Likert scale ranging from 1 to 5.

The battery comprising these three scales was validated for use in the Chilean population through expert judgment. Psychometric properties were also analyzed using a sample of 208 teachers. To assess the structure of the battery, confirmatory factor analysis was conducted, and the model demonstrated a good fit: RMSEA = 0.051, $p = 0.411$, CFI = 0.946, and TLI = 0.941. All factor loadings of the items exceeded 0.3, and all coefficients were statistically significant. The correlation between the scales was found to be adequate, indicating sufficient discriminant validity.

Instruments where applied face to face. Teachers were invited to meetings where they completed pen and paper questionnaires before and after the semester.

2.4. Data analysis procedure

A Multilevel Linear Model (HLM) was used. The time of the application (pre- or post-test), the treatment group (experimental or control), and the effect of interaction between the time and the group were assumed as fixed effects, an indicator that accounts for the effect of the intervention. Within the fixed effects, age, gender, years of experience, and post-degree specialization, in the discipline and in teaching, were considered as control variables. As group variables, for the random effects, three nested levels were considered: faculty, pairing block, and teacher.

To establish the statistical significance of the differences in fixed effects between the different mixed models, the likelihood ratio test was used. The difference between the model with interaction effect time x treatment group was tested, which established the efficacy of the treatment. In the case that this effect was significant, the possible existence of interaction effect differences per faculty was analyzed, and the estimated means for the control and experimental groups were calculated at both moments of application.

To verify the assumptions of the linear model, the residuals of each model in each level were analyzed. In particular, a boxplot analysis of the semi-standardized residuals of level 1 (application) was carried out, per intervention group and time, to detect heteroscedasticity and bias in the residuals per group using the "lineup" methodology (Wickham et al., 2014).

3. Results

3.1. Effect on knowledge about self-regulated learning

The interaction effect between time (pre/post) and groups (control/experimental) was not significant. This implies that the treatment did not cause changes in the participants' knowledge. Table 1 shows the means in both times for the experimental and control group, while Table 2 shows the fixed and random effects of the knowledge prediction model on the promotion of self-regulated learning.

3.2. Effects on teacher self-efficacy

The interaction between time and groups was significant. The treatment caused changes in teacher self-efficacy. When carrying out the residue analysis at the faculty level, the residues of Health Sciences and Psychology were much greater. Therefore, it was decided to adjust a new model considering an interaction effect of the treatment for these two faculties. The likelihood ratio test showed that the difference for the latter was significant: $\chi^2(1) = 9.0$, $p = 0.01$. The effect in Health Sciences and Psychology was 0.37 points higher than in the other faculties. This second model fulfills the assumptions of the linear model.

In terms of random effects, the greater variability can be attributed to the differences between teachers and, secondly, to residues, which indicates that their results are maintained over time. By adding the differential effect of the treatment in Health Sciences and Psychology, the random effect of group treatment within the faculty is annulled. Table 3 shows the means in both times for the experimental and control group, while Table 4 shows the fixed and random effect models of the teacher self-efficacy prediction model.

3.2.1. Effect on efficacy in managing the classroom

The effect of interaction between time and groups was not significant. When reviewing the residuals, these were much greater in Health, Psychology, and Economics and Business. Due to this, a new model was adjusted, which considers the interaction effect for these three faculties. When performing the likelihood ratio test for the latter, the difference was significant: $\chi^2(1) = 7.32$, $p = 0.01$. In this model, the interaction effect of time and groups was significant, whereas the differences per faculty regarding the treatment disappeared, being significant only for Health Sciences, Psychology, and Economics and Business. This implies that the treatment in this variable was more effective for the teachers belonging to these faculties, which was 0.34 points higher. This second model fulfills the assumptions of the linear model with properly functioning residuals.

When comparing the size of the random effects, the greater variability can be attributed to the differences between teachers and, secondly, to the residuals, which indicates that their results are maintained over time. By adding the differential effect of treatments in Health Sciences, Psychology, and Economics and Business, the random effect of group treatments within the faculty is annulled. Table 5 shows the means in both times, for the experimental and

TABLE 1 Estimated means and confidence intervals for control and experimental groups in the pre- and post-tests.

	Time			
	Pre		Post	
Group	M	CI 95%	M	CI 95%
Control	4.40	[4.19, 4.61]	4.54	[4.30, 4.76]
Experimental	4.44	[4.18, 4.70]	4.55	[4.25, 4.84]

TABLE 2 Fixed and random effects of the knowledge prediction model on the promotion of self-regulated learning.

Parameters	Estimator
Fixed effects[a]	
Intercept	−0.15 (0.32)
Level 1: Application time	
Time = Post-test	0.38 (0.22)
Time × group	−0.08 (0.26)
Level 2: Teachers	
Group = Experimental	0.11 (0.23)
Age	0.01 (0.02)
Gender = Man	−0.75 (0.26)
Disciplinary specialization = yes	0.02 (0.24)
Specialization in teaching = yes	0.26 (0.23)
Years of experience	−0.001 (0.02)
Random effects[a]	
Level 4: Faculty	
Intercept	0.04
Time = Post-test	0.05
Group = Experimental	0
Time × group	0
Level 3: Pairing block	
Intercept	0.13
Level 2: Teacher	
Intercept	0.27
Level 1: Application	
Residual	0.49

[a]For the fixed effects, β was used, while for the random effects, the variance was used.

TABLE 3 Estimated means and confidence intervals for the control and experimental groups in the pre- and post-tests.

	Time			
	Pre		Post	
Group	M	CI 95%	M	CI 95%
Health sciences and psychology				
Control	7.64	[6.62, 8.67]	7.37	[6.31, 8.42]
Experimental	7.43	[6.24, 8.62]	7.92	[6.71, 9.13]
Other faculties				
Control	8.07	[7.40, 8.75]	7.81	[7.12, 8.51]
Experimental	7.28	[6.55, 8.01]	7.23	[6.61, 8.67]

control group, while Table 6 shows the fixed and random effect models of the efficacy prediction model to manage the classroom.

3.2.2. Effect on efficacy to involve students in learning

The effect of interaction between time and groups was not significant. When reviewing the residuals, these where much greater in Health Sciences. Because of this, a new model was adjusted that considers the interaction effect for this faculty. When performing the likelihood ratio test for the latter, the difference was significant: $\chi^2(1) = 5.26$, $p = 0$ 0.02. In this model, the interaction effect of time and groups was significant, eliminating the differences per faculty for the treatment, being only significant for Health Sciences. This implies that the treatment in this variable was more effective for the teachers belonging to this faculty, being 0.44 points higher. This second model fulfills the assumptions of the linear model with properly functioning residuals.

When comparing the size of the random effects, the greater variability can be attributed to the differences between teachers and, secondly, to the residuals, which indicates that their results are maintained over time. By adding the differential effect of the treatment in Health Sciences, the random effect of group treatment within the faculty was annulled. Table 7 shows the means in both times for the experimental and control group, while Table 8 shows the fixed and random effect models of the efficacy prediction model to involve the student.

3.2.3. Effect on efficacy for instructional strategies

The effect of interaction between time and groups was significant. When reviewing the residuals, they behaved normally. Moreover, they showed no differences between faculties, and the assumptions of the linear model were fulfilled. The treatment was effective independently of the teacher's faculty.

When comparing the size of the random effects, the greater variability can be attributed to the residual variance (between each application), which indicates that the teachers varied their response between time 1 and 2 (pre and post). This cannot be explained by the variables of the model. The second variability can be attributed to the differences between teachers and faculties. Table 9 shows the means in both times for the experimental and control group, while Table 10 shows the fixed and random effects model of the efficacy prediction model for instructional strategies.

3.3. Effect on practices for the promotion of self-regulated learning

In relation to the effect of interaction between time and groups, the hierarchical linear model was significant. When reviewing the residuals, they behaved normally. Moreover, there were no differences between faculties, and the assumptions of the linear model were fulfilled. The treatment was effective independently of the teacher's faculty.

When comparing the size of the random effects, the greater variability can be attributed to the differences between teachers and, secondly, to the residuals, which indicates that their results were maintained over time. Table 11 shows the means in both times for the experimental and control group, while Table 12 shows the model of fixed and random effects of the efficacy prediction model for practices that promote self-regulated learning.

4. Discussion

The training program yielded significant changes in self-efficacy and self-regulation promotion practices, making a valuable

TABLE 4 Fixed and random effect models of the teacher self-efficacy prediction model.

Parameters	Model 1[a]	Model 2[b]
Fixed effects[c]		
Intercept	−0.43 (0.28)	0.41 (0.28)
Level 1: Application time		
Time = Post-test	−0.28 (0.09)**	−0.28 (0.10)
Time × group	0.48 (0.19)*	0.22 (0.17)
Group × time × Faculty = Health or Psychology		0.59 (0.18)*
Level 2: Teachers		
Group = Experimental	−0.51 (0.27)	−0.48 (0.24)
Age	−0.01 (0.02)	0.01 (0.02)
Gender = Man	0.10 (0.24)	0.10 (0.24)
Disciplinary specialization = yes	−0.32 (0.24)	−0.32 (0.24)
Specialization in teaching = yes	−0.02 (0.21)	−0.02 (0.21)
Years of experience	0.001 (0.02)	0.01 (0.02)
Random effects[c]		
Level 4: Faculty		
Intercept	0.01	0.02
Time = Post-test	0	0.01
Group = Experimental	0.10	0.05
Time × group	0.09	0
Level 3: Pairing block		
Intercept	0	0
Level 2: Teacher		
Intercept	0.50	0.50
Level 1: Application		
Residual	0.44	0.44

*$p < 0.05$; **$p < 0.01$.
[a]Model considers differences in treatment per faculty as a random effect.
[b]Model considers differences in the treatment per faculty as a random effect and specific differences for Health Sciences and Psychology.
[c]For fixed effects, β was used, while for random effects, the variance was used.

TABLE 5 Estimated means and confidence intervals for the control and experimental groups in the pre- and post-tests.

	Time			
	Pre		Post	
Group	M	IC 95%	M	CI 95%
Health sciences, psychology, and economy and business				
Control	7.87	[5.27, 10.50]	7.55	[4.25, 10.68]
Experimental	7.50	[3.67, 11.32]	8.02	[3.96, 12.06]
Other faculties				
Control	7.98	[7.08, 8.89]	7.73	[6.81, 8.66]
Experimental	7.28	[5.79, 8.50]	6.93	[5.50, 8.35]

TABLE 6 Fixed and random effect models of the efficacy prediction model to manage the classroom.

Parameters	Model 1[a]	Model 2[b]
Fixed effects		
Intercept	0.57 (0.32)	0.56 (0.31)
Level 1: Application time		
Time = Post-test	−0.28 (0.17)	−0.28 (0.17)
Time × group	0.51 (0.31)	−0.03 (0.33)
Group × time × Faculty = Health, Psychology, and Economics and Business		0.85 (0.33)**
Level 2: Teachers		
Group = Experimental	−0.49 (0.26)	−0.48 (0.24)
Age	0.01 (0.02)	0.01 (0.02)
Gender = Man	0.12 (0.28)	0.10 (0.24)
Disciplinary specialization = yes	−0.49 (0.27)	−0.32 (0.24)
Specialization in teaching = yes	0.02 (0.24)	−0.02 (0.21)
Years of experience	0.01 (0.02)	0.01 (0.02)
Random effects		
Level 4: Faculty		
Intercept	0	0
Time = Post-test	<0.01	0
Group = Experimental	0	0
Time × group	0.15	0
Level 3: Pairing block		
Intercept	0	0
Level 2: Teacher		
Intercept	0.55	0.54
Level 1: Application		
Residual	0.42	0.41

**$p < 0.01$.
[a]Model considers differences in treatment per faculty as a random effect.
[b]Model considers differences in the treatment per faculty as a random effect and specific differences for Health Science, Psychology, and Economics and Business.

TABLE 7 Estimated means and confidence intervals for the control and experimental groups in the pre- and post-tests.

	Time			
	Pre		Post	
Group	M	IC 95%	M	CI 95%
Health sciences				
Control	7.62	[5.79, 9.45]	7.22	[5.35, 9.09]
Experimental	7.56	[3.80, 11.33]	8.06	[4.26, 11.87]
Other faculties				
Control	7.64	[6.92, 8.36]	7.45	[6.77, 8.24]
Experimental	7.17	[6.14, 8.21]	6.98	[5.94, 8.02]

contribution to the field. This is particularly noteworthy considering the recommendations of various authors, such as Gibbs and Coffey (2000, 2004), Postareff et al. (2007), Devlin (2008), and Stes et al. (2010a), who emphasize the importance of basing teacher training on empirical findings and publishing the results and impacts on variables related to the teaching–learning process. This study specifically reports

TABLE 8 Fixed and random effect models of the efficacy prediction model to involve the student.

Parameters	Model 1[a]	Model 2[b]
Fixed effects[c]		
Intercept	0.34 (0.32)	0.33 (0.31)
Level 1: Application time		
Time = Post-test	−0.29 (0.17)	−0.29 (0.17)
Time × group	0.31 (0.29)	0.06 (0.29)
Group × time × Faculty = Health		0.75 (0.30) *
Level 2: Teachers		
Group = Experimental	−0.37 (0.36)	−0.33 (0.34)
Age	0.02 (0.02)	0.02 (0.02)
Gender = Man	−0.04 (0.28)	0.03 (0.28)
Disciplinary specialization = yes	−0.13 (0.27)	−0.12 (0.27)
Specialization in teaching = yes	−0.21 (0.24)	−0.20 (0.24)
Years of experience	0.01 (0.02)	0.01 (0.02)
Random effects[c]		
Level 4: Faculty		
Intercept	0	<0.01
Time = Post-test	0	0
Group = Experimental	0.25	0.20
Time × group	0.13	0
Level 3: Pairing block		
Intercept	0	0
Level 2: Teacher		
Intercept	0.54	0.54
Level 1: Application		
Residual	0.38	0.38

*$p < 0.05$.
[a]Model considers differences in treatment per faculty as a random effect.
[b]Model considers differences in the treatment per faculty as a random effect and specific differences for Health Sciences.
[c]For the fixed effects β was used, while for the random effects, the variance was used.

TABLE 9 Estimated means and confidence intervals for the control and experimental groups in the pre- and post-tests.

	Time			
	Pre		Post	
Group	M	IC 95%	M	CI 95%
Control	8.13	[7.54, 8.71]	7.93	[7.32, 8.53]
Experimental	7.62	[6.95, 8.29]	8.01	[7.26, 8.77]

TABLE 10 Fixed and random effects model of the efficacy prediction model for instructional strategies.

Parameters	Model[a]
Fixed effects	
Intercept	−0.29 (0.35)
Level 1: Application time	
Time = Post-test	−0.23 (0.19)
Time × group	0.67 (0.25)**
Level 2: Teachers	
Group = Experimental	−0.57 (0.24)*
Age	0.01 (0.02)
Gender = Man	0.34 (0.27)
Disciplinary specialization = yes	−0.31 (0.26)
Specialization in teaching = yes	0.08 (0.25)
Years of experience	−0.01 (0.02)
Random effects	
Level 4: Faculty	
Intercept	0.35
Time = Post-test	0
Group = Experimental	0
Time × group	0
Level 3: Pairing block	
Intercept	0.14
Level 2: Teacher	
Intercept	0.35
Level 1: Application	
Residual	0.46

*$p < 0.05$, **$p < 0.01$.
[a]For the fixed effects β was used, while for the random effects, the variance was used.

TABLE 11 Estimated means and confidence intervals for control and experimental groups in the pre- and post-tests.

	Time			
	Pre		Post	
Group	M	IC 95%	M	CI 95%
Control	3.64	[3.27, 4.02]	3.46	[3.03, 3.89]
Experimental	3.37	[2.80, 3.93]	3.74	[3.15, 4.33]

the impact of the teacher training program on the three teacher variables discussed in the introduction.

Regarding general self-efficacy, an interaction effect was observed based on the faculty of origin of the teachers, with a more pronounced effect in Health Sciences and Psychology. Similarly, an interaction effect was found for the effectiveness of classroom management, with Health Sciences, Psychology, and Economics and Business teachers experiencing significant changes. The same pattern emerged for self-efficacy in engaging students in the learning process, indicating the program's effectiveness in the Faculty of Health Sciences. However, in terms of the effectiveness of instructional strategies, changes were observed across all faculties.

These results align with the findings of Postareff et al. (2007, 2008), supporting the notion that teacher training impacts teacher self-efficacy. However, these authors suggest that longer-term training is necessary to achieve these changes. The interaction effects observed in this study may be attributed to the disciplinary characteristics of the teachers, although this was not measured. Notably, the program had a greater impact on teachers from the Faculty of Health Sciences, followed by Psychology and Economics and Business.

Additionally, the findings are consistent with the conclusions of Stes et al. (2010b), who propose that the effectiveness of teacher

TABLE 12 Model of fixed and random effects of the efficacy prediction model for practices that promote self-regulated learning.

Parameters	Model[a]
Fixed effects	
Intercept	−0.28 (0.34)
Level 1: Application time	
Time = Post-test	−0.29 (0.23)
Time × group	0.87 ($p < 0.01$)*
Level 2: Teachers	
Group = Experimental	−0.29 (0.23)
Age	−0.01 (0.02)
Gender = Man	0.06 (0.27)
Disciplinary specialization = yes	−0.33 (0.27)
Specialization in teaching = yes	−0.12 (0.24)
Years of experience	0.02 (0.02)
Random effects	
Level 4: Faculty	
Intercept	0.08
Time = Post-test	0.10
Group = Experimental	0.25
Time × group	0
Level 3: Pairing block	
Intercept	<0.01
Level 2: Teacher	
Intercept	0.50
Level 1: Application	
Residual	0.38

*$p < 0.01$.
[a]For the fixed effects β was used, while for the random effects, the variance was used.

training does not vary based on years of teaching experience, as observed in the present study. However, there was a divergence regarding the lack of differences based on disciplinary area. These authors criticize previous study designs for not including control groups and not employing multilevel models for data analysis, as was done in the present study. The inclusion of these features may have influenced the detection of these differences, suggesting the importance of conducting further research to explore the impact of teacher training based on disciplinary areas.

The program also demonstrated an impact on practices for promoting self-regulated learning. It is worth noting that the training specifically targeted this variable by directly working with teachers through teaching, reflection, and the design of planning, teaching, and learning assessment practices.

In contrast, the program did not show an impact on knowledge about self-regulated learning. This could be attributed to the high initial scores of both groups, making it challenging to increase them further. Moreover, knowledge is intertwined with teaching beliefs (Pajares, 1992), which previous studies have shown to be difficult to transform, often requiring long-term training programs to achieve meaningful change (Gibbs and Coffey, 2004; Postareff et al., 2007, 2008; Stes et al., 2010a,b). Consequently, a potential avenue for future research related to this finding could involve implementing the same intervention with an extended duration to assess variables associated with teaching beliefs, such as teaching approaches measured by the “Approaches to Teaching Inventory.” This dimension has been extensively studied worldwide (Gibbs and Coffey, 2004; Postareff et al., 2007, 2008; Stes et al., 2010a,b), but requires more time to be effectively transformed.

The limitations of this study pertain to its design as it lacked control over other variables. However, it is challenging to conduct experimental studies in the educational field.

In conclusion, this study highlights the effectiveness of a teacher training program in enhancing self-efficacy and promoting self-regulated learning practices among university teachers. The findings contribute to the existing literature by demonstrating the impact of the program on key teacher variables. The results indicate that the training program had significant effects on self-efficacy and specific areas of practice while not showing significant changes in knowledge about self-regulated learning. The study underscores the importance of incorporating evidence-based training interventions and considering disciplinary differences when designing professional development programs for teachers. Further research is needed to explore the long-term effects of training and its impact on teaching beliefs and approaches. By continuously investing in teacher training and development, we can enhance teaching effectiveness and ultimately improve student learning outcomes.

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 studies involving human participants were reviewed and approved by the Universidad del Desarrollo Research Ethics Committee. The participants provided their written informed consent to participate in this study.

Author contributions

DB developed the study and wrote the article. MP was advisor of the study and reviewed the article. CB was statistics advisor and helped with data analysis. VV helped with the data collection and reviewed the article. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The 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.

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