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Professional Development Program to Promote Active Learning in an Engineering Classroom*

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This work presents the structure and results of an ongoing engineering faculty development program at a large private university in Chile. This program uses the conceptual change approach as a framework in a recursive way, and it is specially designed to promote and ensure the use of active and innovative methodologies. The development program consists of six steps that aim to strengthen a learning community that fosters interaction of professors with common problems, interests, and experiences in a way that the collegial work sustains over time the dynamic and improved incorporation of active methodologies for teaching and learning. For this paper, we focus on the structure and some results. The results are related to faculty, students and institutional perceptions. We have evidence that faculty in this program changes their own perceptions as instructors towards reflecting whether their role is less regarding to transmitting knowledge, notes, and presentations to students. In the case of students, after a survey in courses in which participants were implementing educational strategies from the program, students' view is positive towards the activities. Students indicated that they learned more and that those strategies should be used in other courses. Institutionally, the achievements of faculty in the program and the program itself received recognition by the university.

Keywords: active learning; engineering education

1. Introduction

Many countries are carrying out actions to increase the number of professionals in the STEM areas. To this end, they are making recommendations that favor the adoption of empirically validated teaching practices to help achieve that objective by increasing retention, encouraging inclusion, favoring timely titling, etc. [1].

Particularly in the case of engineering, since the late 90's the consensus regarding the change in the way professional training is conceived is that teachers need to relinquish the role of information providers, while students must abandon the passive role of recipients of that information. Thus, it is necessary to transform education into a model with a focus on students and their learning [2–4].

The current demand for the university is to train flexible professionals capable of acting in a changing world in which new needs and new problems to solve continually arise. This scenario requires training in which creative and innovative processes, teamwork skills, tolerance to failure, and many other skills are reinforced. Faced with these challenges it is necessary to modify the training to include methodologies that favor the acquisition of skills and strategies for the management, analysis, evaluation, and retrieval of information. These methodologies should allow more durable and flexible learning that guides critical and innovative thinking and the ability to learn day by day. Active learning, in its multiple variants, involves students in their learning process through meaningful activities that make them think and build their knowledge. There is enough evidence to support that active learning leads to increases in test performance and that, comparatively speaking, failure rates in traditional classes are 50% higher than in classes oriented to active learning [1]. These improvements, in comparison to traditional teaching, have been reported for all STEM disciplines, regardless of the size of the class and the type and level of the course, although there is evidence that active learning is particularly beneficial in small classes. Also, a deeper involvement of students and the development of general skills have been documented through the incorporation of active learning strategies in class [5].

Active learning methodologies appear to improve conceptual understanding and thinking skills for flexible use of science and technology students. Although there is clear evidence for the benefits of active learning, professors still use traditional teaching methods [4]. The shift from a teacher-centered teaching practice to one centered on students' needs

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and learning outcomes is not easy [6]. However, we all agree that this is something worth doing to prepare professionals to work in a world that does not exist yet and to solve problems that we do not even recognize today.

To be fair, we must mention that teachers are not resistant to change because they want to be that way. They resist because in their vast majority they are comfortable teaching as they were taught. Engineers are not formally trained for the teaching task. Also, in every field, any innovation only attracts a small percentage of followers. Referring to Rogers' innovation adoption curve [7] we may say that there are just a few innovative teachers, a few willing to adopt the methodological innovations, many pragmatics and strongly conservative whose beliefs are challenging to modify, and finally some teachers who are skeptical. The latter is our target group, teachers we need to motivate through interactions to build a community of practice that moves towards massive incorporation of active methodologies into the classroom.

We need to motivate teachers to change their teaching-learning paradigm by creating opportunities that allow them to reflect and rethink their practices. They will be willing to change when they entertain the possibility of increasing classroom interactions and decrease teacher control while achieving the course objectives and improving learning outcomes. In this scenario, the Continuous Faculty Development Program (CFDP) and the Workshop on Active Learning in Engineering (WALE) at the School of Engineering were designed to provide tools that allow the teacher to incorporate active learning methodologies in their teaching under the following assumptions:

(i) Active learning strategies are central to professional development in engineering [1, 5].
(ii) Methodological innovations are difficult to adopt by a large percentage of teachers [4, 6].
(iii) An institutional training program needs a convergence of conditions to sustain effectiveness: institutional support, economic and human resources, collaborative culture, and necessary agreements and decisions on the characteristics of the educational system to be achieved [8].
(iv) Knowledge is situated in the day-to-day lived experiences of teachers and best understood through critical reflection with others who share the same experience [9].
(v) Learning communities engage teachers actively in professional learning courses, increase their professional knowledge and enhance student learning [9, 10].
(vi) Training teachers with generic teaching skills is not that effective. We need to go to the core of teachers' conceptions about teaching and learning to generate fundamental changes in their practice to improve their students' learning outcomes [11].
(vii) It is possible to assess the effect of a professional development program by identifying and comparing the conceptions of teaching before and after the program [11, 12].

2. The context

Founded in 1988, Universidad Andrés Bello (UNAB) is recognized in Chile by the National Accreditation Commission (CNA for the acronym in Spanish) and accredited by the Middle States Commission on Higher Education (MSCHE) in the US. It is one of the 50 best universities in Latin America according to the "Best Global Universities in Latin America" ranking by Clarivate Analytics. In January 2018, the university headed for the seventh consecutive year the preferences of students entering in higher education. This means that the UNAB has one of the largest engineering schools in Chile (approximately 8500 students) with a presence in three cities: Santiago, Viña del Mar, and Concepción. The Engineering School offers 17 majors in various areas such as civil, earth sciences, industrial processes, computer science, among others, and has approximately 110 full-time professors and about 600 part-time instructors.

The proposed workshops and activities allow the participants to understand the need of a paradigm shift in teaching, to design and implement educational innovation projects aimed at solving current problems related to quality in higher education, and to evaluate the intervention as well as its design. To this end, we based on [13] to identify the principal agents and their interactions, understanding that each one "represents a subsystem of the university (i.e., a collection of people, structures, and norms) that can be acted upon by a change process, with different types of change processes being appropriate for different levels" [13, p. 010113-2]. In our case, we have four main elements: administration, program departments, faculty, and UNIDA with the following roles.

- *Administration*. Refers to the administration of the School of Engineering. This level is composed of the Dean and the Academic Council. In addition, at this level, there is support staff such as assistants and secretaries.
- *Academic program office*. The reference framework [13] talks about departments. However, in the School of Engineering of the UNAB, there are no academic departments. The organizational

Table 1. Interactions among levels of the university and UNIDA. (Adapted from [13])

	By administration	By academic program office	By faculty	By UNIDA
On administration		Defining priorities and requesting resources	Faculty subcommittees	Vision and framework
On academic program office	Academic Council		Committee work	Support and alignment process
On faculty	Ensuring academic quality in all sites	Coordinated evaluations in all sites		Team of participants at each site every year

structure is by means of the program chair, the person responsible for students and instructors of that program. At this level, along with the program chair, there are academic secretaries and assistants.

- *Faculty*. All instructors, full time and part-time, teachers and researchers. At UNAB, the teaching load is quite high, a regular load for an instructor is five courses (4-hour classroom each), whereas for a researcher the teaching load is half that of a teacher.
- *UNIDA*. The Teaching and Academic Innovation Unit (UNIDA) is a unit within the School of Engineering dependent on the Undergraduate Department whose primary mission is to promote and ensure the use of Active and Innovative teaching methodologies. UNIDA is composed of three professors/researchers. It is projected to have a representative in each site in the short term.

The interaction among the above levels in relation to UNIDA are indicated in Table 1. Each level of the university plays an important role in the shift towards a new teaching paradigm. In particular, the administration support to UNIDA is instrumental in opening a channel of communication with the academic program offices and to the faculty; as well as, to support the professional development activities and research projects develop by UNIDA.

3. Structure of the program

This in-service teacher preparation program for the engineering faculty is specially designed to promote and ensure the use of Active and Innovative Methodologies. Moreover, it aims to strengthen a learning community that fosters interaction of professors with common problems, interests, and experiences in a way that the collegial work sustains over time the dynamic and improved incorporation of active methodologies for teaching and learning [14].

The three-semester faculty development program consists of six sequential steps (Fig. 1 and Fig. 2). Steps alternate from full-time faculty participants (around 80 professors) to a selected subgroup of participants (about 20 professors). That is, in steps 1, 3 and 5 all 110 professors are invited (approximately 80 attend), while in steps 2, 4 and 6 we work closely with the selected subgroup. The activities for all faculty (steps 1, 3 and 5) are short interventions. The Workshop on Active Learning in Engineering

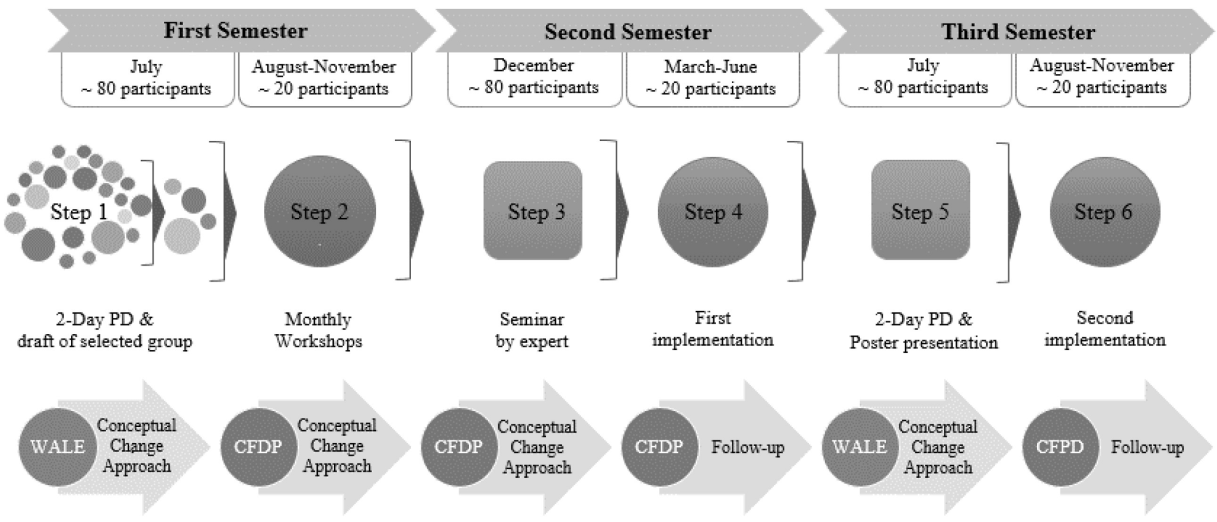

Fig. 1. Six sequential steps program. Steps 1, 3 and 5 are open for the entire full-time faculty and are short (one or two days). Steps 2, 4 and 6 are closed activities for the selected group of participants and last one academic semester each.

				First semester					Second semester					Third semester				
Step	Description	Program	July	August-December					March - July					August - December				
1	2-day PD 1	WALE	■															
	Candidates draft		■															
2	Monthly workshop	CFDP		■	■	■	■	■										
3	Seminar (expert)	CFDP						■										
4	Implementation 1	CFDP							■	■	■	■	■					
5	2-day PD 2	WALE											■					
6	Implementation 2	CFDP												■	■	■	■	■

Fig. 2. Gantt chart of the six sequential steps program. Continuous Faculty Development Program (CFDP) at each site and Workshop on Active Learning in Engineering (WALE) at the main site.

(steps 1 and 5) lasts two days and requires the entire full-time faculty to convene in the main Campus. The seminar (step 3) is two hours long, and the guest delivers a talk at each of the three different cities. The activities for the selected group (steps 2, 4 and 6), Continuous Faculty Development Program (CFDP), last one academic semester each and take place at each of the three campuses in different cities.

Previous works [4, 11–12], suggest an approach to professional development that is based on the conceptual change theory [15] and pay attention to four separate elements:

(1) *Self-reflection:* participants undergo self-reflection and clarify personal conceptions.
(2) *Confrontation:* participants are brought to realize possible inadequacies in their existing conceptions and teaching practices and thus create awareness for the need to change.
(3) *Exposure:* workshop facilitator provides a direction and a model for improvement.
(4) *Commitment building:* workshop facilitator encourages teachers to engage in changes and development.

The entire program uses the conceptual change approach as a framework in a recursive way [12, 15]. That is, the conceptual change approach is used to structure the entire program, as well as four of the steps within the program (Steps 1, 2, 3 and 5). The

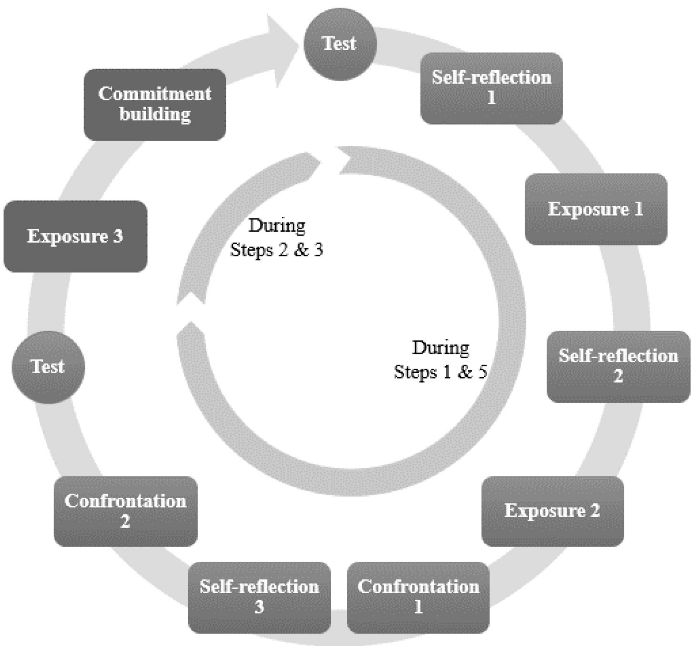

Fig .3. Conceptual change approach implemented during the first three steps of the program. This cycle starts and ends with a test that is used to measure participants change of perspectives.

description of the six sequential steps for the program is as follows.

3.1 Step 1—WALE: focus on raising awareness about the need for change

The focus of this step is to raise awareness of the need for active learning to prepare the new generations of students. To this end, all full-time faculty of the School of Engineering participates in a 2-day workshop. From that workshop, 20 persons are invited to join in the three-semester program.

The objective of the 2-day workshop "Active Learning in Engineering" (Step 1) is to convene the entire full-time engineering faculty to send a clear and sound message that the whole school shifts to active learning methodologies. To that end, the workshop program is structured according to the conceptual change approach [12, 15]. It starts with a welcoming message from the Dean of the School of Engineering and the Academic Vice Chancellor followed by a plenary talk by an expert on active learning on engineering. The expert is asked to frame his/her speech towards a guiding topic that will emerge through the entire workshop.

3.2 Step 2—CFDP: focus on shifting into the active learning paradigm

As we mentioned before, a group of faculty members is selected to continue their training in the Continuous Faculty Development Program (CFDP) at each of the sites (Santiago, Viña del Mar, and Concepcion). The selection criteria consider only full-time faculty members and favor those having any previous training in higher education.

This program starts with three monthly 4-hours sessions addressing the following topics:

- Introduction to collaborative learning
- Inquiry-based learning
- Aligning teaching and assessment

The sessions are designed based on active learning techniques for the participants to experience learning the way they are expected to promote it in their classes, Exposure 3 in the Conceptual Change Approach (Fig. 3). As part of the monthly assignment, participants design and implement activities in one of their courses, they document the activity and reflect upon that experience; specifically, about how they perceive students' response to the methodology and how they feel about changing their role and empowering students about their learning. Participants share their reflection and evidence of implementation to their peers at the beginning of the following session.

The activities developed during the first semester corresponding to the long intervention (CFDP in Step 2) showed a positive change in the conception of the teachers' role in active learning strategies. We obtained evidence to attest that, regarding the need to change the paradigm from teacher-centered to student-centered learning process; it is not effective for those faculty members to take general development programs. Faculty development workshops focused on successful teaching strategies that are documented to work well in the discipline are needed instead [4].

3.3 Step 3—CFDP: focus on commitment building

The third step consists of a seminar offered by a distinguished researcher on engineering faculty development. The topic focuses on challenges that arise in the implementation of innovations in university classrooms and in ways to overcome them. This activity is open for all engineering faculty and is carried out in the three campuses of the university (Santiago, Viña del Mar, and Concepción).

After the seminar, the invited researcher meets with the participants of the CFDP 1. In the first part of that closed session, participants share their experiences on implementing active learning from Step 2, focusing on difficulties encountered, lessons learned and reflections about the role of the instructor and the student under the new teaching paradigm. The invited researcher offers feedback and reinforces the main pillars of active learning. One of the objectives of this session is for participants to set a commitment regarding the innovations to be developed the following semester in their courses, as indicated in the Conceptual Change Approach (Fig. 3). Therefore, in the second part of the closed session, each participant commits to actions to be carried out the following semester, identifies what he/she would need to implement them, and creates links with the other teachers as a support network.

The Approaches to Teaching Inventory (ATI) is used to measure how the participants' view of the role of the teacher as the center of information and the role of students as empowered of their learning changes over time. An expected outcome is a decrease in a teacher-centered approach and an increase in a student-centered approach. The activities developed during the first semester corresponding to the long intervention (CFDP in Step 2 and Step 3) showed a positive change in the conception of the teachers' role in active learning strategies. These results generated positive expectations regarding the quality of the innovations that would be designed for the following semester.

3.4 Step 4—CFDP: focus on classroom activities

In this step, participants design and implement active learning strategies in an engineering course. We offer follow-up sessions for feedback on their design, implementation, and evaluation.

Sixteen innovations were designed and documented, corresponding to the works developed by the participants of the CFDP-1. The teachers worked on the learning problems they wanted to undertake, the design of activities, the gathering of evidence of improvements in student performance, reflection on difficulties and possibilities for improving the proposal, among other activities. They prepared a report of the activities and collected evidence thinking about the next step of this program, the sharing step, where they present their experience to the other professors of the faculty.

Also, four of these well-documented innovations were the subject of presentations at an international congress on educational innovation in Mexico, where teachers attended with funding by the Engineering School.

3.5 Step 5—WALE: focus on collaborating and sharing experiences

This activity is like the one of Step 1, that is, it is a 2-day workshop for all faculty members from all three campuses (Santiago, Viña del Mar, and Concepción). The first time that the workshop took place was different because there was no sharing step between peers (Fig. 4). The conceptual change approach is used to structure the activities in the same way as the previous edition.

The main difference is a sharing activity in which the participants present in poster format their experience implementing active learning in their courses, that is, their implementation in Step 4. Participants of the Continuous Faculty Development Program presented in a poster session to share their experience. Personalities such as the Dean and Associate Dean of the School of Engineering, the Academic Vice President and the General Director of Teaching of the university also attended to the poster presentation. Having the full support of the School has been fundamental in sending a clear message of the importance of the change from a traditional teaching paradigm to one based on active learning [14].

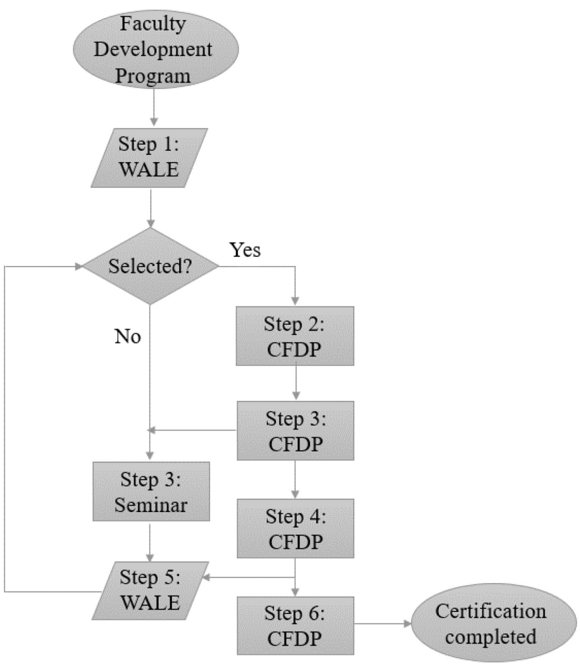

Fig. 4. Faculty development program cycle.

3.6 Step 6—CFDP: implementation after feedback

In this step, participants design and implement an active learning strategy in an engineering course based on the learning and experience from the previous year (Steps 1 through 5). The trainers offer follow-up sessions to guide participants in their design, implementation and evaluation process. In this step, participants improve their active learning activities focusing on implementing a more structured set of activities since the first day of classes. The rationale is to set a tone and rhythm to the class and to empower students since the beginning of the semester.

4. Results

We present three pieces of evidence that this program is in the right direction. The results are related to faculty, students and institutional perceptions, in that order.

4.1 First generation ATI

Ho et al. [11] and Walter and Kautz [12] studied the effectiveness of their respective educational changes in relation to modifications in teachers' models to conceptualize teaching and learning. Ho et al. evaluated the effect of their program by identifying and comparing participants' conceptions of teaching through semi-structured interviews conducted before and after the program. In the case of [12], they used the 16-item questionnaire *Approaches to Teaching Inventory* (ATI), developed by Trigwell and Prosser [16]. In the present work, we adapted into Spanish [4] a different version of the ATI questionnaire [17] which is a 22-item, instead of 16, to implement with instructors in the program (ATI-22).

This questionnaire contains two different kinds of items:

- Teacher-focused approach to teaching (TF), related to the "information transmission" way of teaching.
- Student-focused approach to teaching (SF), related to a "student conceptual change" way of teaching.

The items present different aspects representing certain characteristics of the teaching and learning situation in a teacher-centered approach or a student-centered approach. Teachers expressed their agreement on a Likert scale: 1 for "only rarely" to 5 for "almost always." The 22-item version [17] contains 11 "teacher-focused" and 11 "student-focused" statements.

We implemented the questionnaire three times. ATI-22 was administered to all participants to the Teaching Workshop before it started as PRE (before step 1, Fig. 4). In the first administration, CFTP members were included. Then, there was a second administration of the ATI-22 as a post-test (POST-1, after step 1) at the end of the Teacher Workshop, in which all participants, including CFTP members, took part. In this case, participants were asked to fill out the ATI-22 thinking about what they planned to do the following semester. We wanted to see whether there was a change due to the workshop. The third time was after a semester-long training program (at the end of step 3), only for CFTP members, which concluded that part of the program (POST-2). In this work, we present results only for CFTP members from the PRE to POST-2. For details of all administrations, please refer to [4].

Answers to the survey before and after the development program showed significant differences on 6 of the 22 items ($N= 20$, $p < 0.05$) and marginally significant differences on two items ($p< 0.07$). Table 2 presents the results of the items in which there was a difference. Seven of these eight items belong to the "teacher-focused" scale of the instrument, and showed changes in the intended direction, towards lower rates. In the case of item 5 (student-focused scale), the move was in the opposite direction.

The changes after the four-month program appeared in some items of the teacher-focused scale; seven out of eight items in which there was change, were in this dimension. It is significant that the CFTP members improve their perception as teachers, and not in the student-focused dimension. It is consistent with the work done in the different workshops in which we focus on collaborative and active learning strategies such as inquiry-based education, aligning teaching and assessment, and the difficulties they could encounter when implementing active learning. All of these workshops promoted, among other objectives, instructors' reflection on their teaching to understand their role as teachers, guiding students to get involved in their learning.

All the statements that changed positively were related to what the teacher can do for students in a knowledge transmission strategy such as statement 10: "I think an important reason for running teaching sessions in this subject is to give students a good set of notes.", statement 15: "In this subject, my teaching focuses on the good presentation of information to students." or statement 18: "My teaching on this subject focuses on delivering what I know to the students." Observe that all statements are based on what the teacher can offer to students: good notes, good presentations, knowledge, in the statements presented, or help, information or answers, for other statements. The program was a success in this respect: it changed the perception of their role as teachers.

During the workshops, participants spent time designing sessions which they used with their students. Instructors were asked to implement the activities they developed; however, at that stage, the activities were used in a class or two, not for an extended period. The objective was to start implementing active learning strategies without having to wait the following semester to implement them on a semester-long basis.

It is interesting to note that the items of the student-focused dimension did not change in the same way as the items of the teacher-focused dimension. There was an item that changed but in the opposite direction. It seems that instructors, in their short implementations, encountered difficulties, probably opposition from students to their activities. This could be due to the way the activity was implemented; that is, with students who were used to the traditional teaching with no introduction to active learning strategies. It may have happened

Table 2. Comparison of eight ATI-22 items for which there was a difference from before and after the four-month development program, step 2 (N = 20)

		Pretest (PRE)		Posttest (POST)			
Item	**SF/TF**	**Mean**	**SD**	**Mean**	**SD**	**t (19)**	**p**
1	TF	3.7	0.642	3.25	1.039	2.269	0.018
5	SF	**3.3**	**1.800**	**2.35**	**1.397**	**2.647**	**0.008**
9	TF	2.9	1.147	2.45	1.313	1.528	0.071
10	TF	2.7	1.695	2.25	1.461	1.577	0.066
11	TF	4.00	1.579	3.05	1.839	2.412	0.013
12	TF	3.85	1.292	3.35	0.871	1.697	0.053
15	TF	3.6	1.200	3.05	1.524	1.927	0.035
18	TF	3.2	1.011	2.6	1.200	2.349	0.015

that students were in opposition since the inexperience of the instructors was evident for them, and probably they did not see any benefit from the change. The only item that changed negatively is statement 5 from the student-focused dimension: "I set aside some teaching time so that the students can discuss, among themselves, key concepts and ideas in this subject."

4.2 Students' survey

To assess whether students had a positive or negative experience in the implementation of the active learning strategies after step 4, we obtained affective responses to the methodologies in the second generation of CFTP members. We used an adapted Spanish version of a six-item questionnaire designed by [18] and added two items, 7 and 8. This decision was taken considering that the engineering school, in which this study took place, is interested in engineering creativity and the application of the discipline in their engineering courses. The two added items read as follow: *The teaching/learning strategy used in this course lessened the development of my creativity* and *The teaching/learning strategy used in this course allowed a better application of the contents*, respectively.

Students were asked to indicate the level to which they agreed with the sentences in the questionnaire. The instrument was a Likert-scale form, from 1, strongly disagree, to 5, strongly agree, with 3 as a neutral point. In this subsection, we report the analysis of the items administered to 319 students from 16 different courses in which the instructors were CFTP members.

The results are in Table 3. Note that there are four positive items and four negative items in the questionnaire. The table presents the actual average and standard deviation for each item. In the *Neutral included* column, the table shows the percentage of students answering strongly agree, agree and neutral for positive items and displays the percentage of students responding strongly disagree, disagree and neutral for the negative items. In the *Neutral not included* column, we do the same sum excluding the neutral option.

The results present a positive attitude toward the implementation of active learning strategies. Six out of eight items have a percentage of 85% or above when including the neutral option. In the cases where that option was not included, the proportion reduces to 70% or above in five out of eight items. The best results occurred in items 1, 4 and 8. The highest scored items are item 1: "*The teaching/learning strategy used in this course is a useful style of teaching and learning*", which has 92% of the "*Neutral included*" column and 83% of the "Neutral not included" column, and item 8: "*The teaching/learning strategy used in this course allowed a better application of the contents*". Item 1 is a general result since it is the first item students see. The importance of the item is that the first impression that students have is positive. Later on, with other items, students answer with essential differences regarding this item, which is an indication that students are taking the survey properly.

Item 8 is also in this category. This is a new item for the application of knowledge which is essential in engineering courses. This result might mean that students appreciate the effort of the instructors to teach with context, something that is emphasized in the program.

The two items with the lowest percentages are item 6: "*The teaching/learning strategy used in this course is not for me*," and item 2: "*I would have learned the content better in a more traditional strategy than the one used in this course*." Both of

Table 3. Affective questionnaire of all students in the 16 different courses in which the instructors were CFTP members (N = 319)

Item	Sentence	Positive/ Negative	Ave	SD	Neutral included	Neutral not included
1	The teaching/learning strategy used in this course is a useful style of teaching and learning	Positive	4.22	1.05	92%	83%
2	I would have learned the content better in a more traditional strategy than the one used in this course	Negative	2.65	1.27	77%	47%
3	The teaching/learning strategy used in this course is inappropriate for university classes	Negative	1.98	1.29	85%	76%
4	The teaching/learning strategy used in this course helped me learn its content	Positive	4.17	1.04	93%	79%
5	Other engineering courses should use the teaching/ learning strategy of this course	Positive	3.92	1.1	91%	68%
6	The teaching/learning strategy used in this course is not for me	Negative	2.29	1.34	82%	63%
7	The teaching/learning strategy used in this course lessened the development of my creativity	Negative	2.04	1.3	85%	71%
8	The teaching/learning strategy used in this course allowed a better application of the contents	Positive	4.06	1.15	90%	75%

them are negative sentences in which comparison to traditional teaching is made. Since this is the first-time students take a course explicitly designed to move away from traditional instruction, we believe that these two items scored low since students are not used to this kind of practice, and they might miss the conventional way. Later, in the discussion section, we will talk about these two items.

A surprising result showed in item 5: "*Other engineering courses should use the teaching/learning strategy of this course*" which has the highest percentage of students answering *Neutral* (23%). We are in the process of interviewing students to understand this result. It could be evidence that students enjoy, in general, the course; however, students probably think that they spend less time in other engineering courses. As we said, we are planning to interview a representative number of students to inquire about this result.

4.3 Impact of the workshop on active learning in engineering

The activities carried out in the 2017 workshop generated considerable interest for teachers to introduce active learning in their classrooms. Therefore, the second call for the Continuous Development Program of the Faculty was carried out through a personal application. Given the high response, it was necessary to carry out a selection process; the requests were more than the available spots. Of the 32 applications received, 25 participants were selected. In this way, three work groups (one in each campus) were created with highly motivated participants committed to the task. There was an improvement in the attendance rate for the workshops and the design of the proposals compared to the first year of the program. So far, there have been only three dropouts, mainly due to the administrative burden of the accreditation process. This new group of 22 teachers implemented their first innovations (Step 4 in Fig. 4) between March and June 2018 and presented their experiences in July 2018 (Step 5).

Institutional support and recognition are required to generate a learning community in the introduction of active learning methodologies in the classroom which it is intended to be maintained over time. Credit is another part of the objective pursued with the "sharing step" of our work. Four participants from the first generation of the Continuous Educational Development Program presented their innovations at an international conference in Mexico in 2017. They were recognized by the Engineering School with a scholarship to pay for their attendance. Two of them received the "Award for Innovation in Teaching" from the Faculty of Education of the institution where this program is implemented. This is significant because only three professors were recognized throughout the university and two were participants of our program [19]. The last result of this work was the achievement of the "Recognition of Outstanding Academic Management" by the work project presented in this document in the UNAB 2018 Academic Council held in January. This recognition was granted to the authors of this document. In the same Council, another member of the faculty of the first generation of participants in the program was recognized as an "Outstanding Faculty" for its innovation in class.

5. Conclusions

This work presented a Faculty Development Program with six steps in a three-semester cycle, which consists of activities for all faculty (steps 1, 3 and 5) that are short interventions. The Workshop on Active Learning in Engineering (steps 1 and 5) lasts two days and requires the entire full-time faculty to convene in the main Campus. The seminar (step 3) is two hours long, and the guest delivers a talk at each of the three sites (three different cities). The activities for a selected group (steps 2, 4 and 6), Continuous Faculty Development Program, last one academic semester each and take place at each of the three campuses in different cities. During the six steps, the entire faculty was able to design Active Learning activities for different topics by working in groups by discipline and sharing their design with everyone. However, the CFDP members had extensive training and time to design and implement during the program.

We presented three sets of results as evidence of success. In the first, we used the *Approaches to Teaching Inventory* (ATI) with CFDP in which instructors changed their view in most of the items in the teacher-focused dimension indicating that workshop activities influenced the way they self-reflect as instructors. The students' opinions regarding the activities during the implementation period are another part of the results. In general, students' view is positive towards the activities and indicated that they learned more and thought the way they were taught should be used in other courses. The last piece of evidence is the achievements results of faculty in the program and the program itself. Members were recognized by the institution, and the program received the "Recognition of Outstanding Academic Management."

This program is designed to promote and ensure sustained use over time of Active and Innovative Methodologies. Also, the aim is to strengthen a learning community that allows for the interaction of professors with common problems, interests and educational experiences. In the present work we presented results which indicate that active learning methodologies are already happening in some courses; however, with time, we will assess whether these methodologies are sustainable over time. Regarding the second objective, we have started the assessment of learning communities by social network analysis; however, at this stage, we do not have results to present. In our perspective, by implementing learning communities with our Faculty, the sustainability of the use of active learning methodologies will be a positive result. In future contributions, we will present the results of our efforts in that direction.

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