The Challenges of Assessing Transformative Learning: Lessons Learned from an Instructional Design Workshop for Colombian Engineering Faculty*

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The authors designed and delivered a workshop on Instructional Design for Colombian engineering faculty at three different universities. The workshop drew from the backwards design model and scholarly literature on engineering education. The participants were asked to assess the workshop using a pre-post survey with Likert-type items and open-ended questions. Results from the assessment of the first offering of the workshop suggested a change in participants' perspectives that the instrument could not fully capture. A revised instrument used during the second offering allowed deeper insights into this change. Based on these results, the authors argue that a professional development program can transform faculty's perspectives, particularly when it is aimed at helping faculty inform their teaching practice using evidence-based educational research. The assessment of such a program must, therefore, move from an incremental to a transformational notion of learning. The research question driving this work was: How can one assess the transformative learning of engineering faculty about instructional design? This experience with Colombian faculty suggests that a transformative learning framework can inform the assessment of participants' learning in professional development programs for engineering faculty. Preliminary results of the application of this framework suggest that most workshop participants transitioned from a teacher-centered to a learner-centered conception of teaching.

Keywords: engineering faculty development; professional development assessment; transformative learning; teaching conceptions

1. Introduction

Engineering faculty, like faculty in many other disciplines, face a significant challenge: often, they have not been formally trained to teach. It is expected that engineering faculty are competent in their disciplinary fields and are, at least, able to teach as they were taught. Nevertheless, this level of teaching performance usually does not meet current standards of quality in engineering education. In response to this situation, the authors designed, delivered, and evaluated a workshop on instructional design for Colombian engineering faculty.

The overarching goal of this workshop was to offer an overview of a tested strategy for course design, namely backwards design [1], and different techniques for assessment of student outcomes and instruction with support of scholarly literature. In addition, the Scholarship of Teaching and Learning (SoTL) was introduced to participants as a stance they may adopt to inform the implementation of innovative educational practices in their classroom. Similarly, through the adoption of a SoTL perspective, they can contribute to the conversation on educational innovation through the scholarly dissemination of their initiatives [2, 3]. In the Latin-American context, an increasing number of institutions are shifting their focus from teaching to research. This, in turn, presents traditionally teaching-oriented faculty with the challenge of also becoming productive scholars. Therefore, introducing SoTL to faculty members with an interest in improving their teaching practice may help them balance their careers as their institutions undertake this transition towards a stronger focus on research [4].

Backwards design was the core tenet for both the development and execution of the workshop. This model was used to develop the learning objectives of the workshop, namely that participants would become able to: (1) write appropriate learning objectives; (2) design innovative instructional experiences; (3) evaluate evidence-based course interventions; and (4) document their educational innovations. The workshop also introduced participants to formative and authentic assessment, as well as active pedagogies. To provide a meaningful experience, participants were encouraged to apply

backwards design notions into the design or revision of courses of their interest. Using this strategy, the workshop provided the opportunity to develop educational innovation skills immediately transferable to their practice.

The twenty-hour workshop was offered four times at three different institutions. The first offering took place in June 2016 at a Colombian private university and the participants held degrees in different engineering disciplines. The next offerings took place during three different weeks of July 2017, one at the same private institution and two at different Colombian public universities, all of them located in different cities. In 2017, most participants came from engineering departments although some of them were faculty with different disciplinary backgrounds (e.g., natural or human sciences) serving engineering programs. The three institutions encouraged their faculty to attend the workshop voluntarily. The backwards design strategy, and most assessment and instruction techniques, were presented through their actual application by the instructors. For instance, the fundamentals of flipped-classrooms were presented through a flipped-lecture and the subsequent discussion during the session. Most activities in the workshop were hands-on and often involved group discussion. Lecturing was purposely limited to a maximum of 20 minutes per session.

After this general overview, the following sections of this paper explore: (1) the context, frameworks, and research question driving this study; (2) the methodology used to execute the workshop and the methods for data collection and analysis; (3) the discussion of the findings; and (4) conclusions and implications for the assessment of transformative learning experiences of faculty.

2. Context and framework

2.1 Backwards design

As mentioned earlier, backwards design was both the design strategy and the overarching theme of the workshop. Backwards design is a model for designing instructional experiences, whether they are workshops, short courses, or formal courses within a curriculum. The idea underlying backwards design is that instructors should first define the outcomes of an instructional experience, and then align the assessment and pedagogical strategies to those outcomes [1]. Although such an approach is rather intuitive, it challenges the typical practice of instructors who usually think of a course in terms of the activities they use to deliver some predefined, structured content [1, p. 8]. In other words, backwards design challenges the notion of structuring courses around the idea of "covering the content",

and advocates considering the logic of learning the content instead [5]. Moreover, such a challenge requires a paradigm shift from a teacher-centered to a student-centered conception of teaching. Backwards design is, therefore, a sound model for ensuring that a professional development experience responds to deliberate instructional aims and learning goals, while at the same time encourages participants to examine their perspectives.

2.2 Transformative learning

Transformative learning is a framework originally devised by John Mezirow to theorize about how adults learn when they return to educational settings. After years of application and evolution, this framework has undergone critiques and revisions, but the underlying idea of exploring adult learning remains at its core [6]. Transformative learning entails a profound change in the learner's assumptions, views, and even values, spurred by a perspective transformation [7, p. 4]. Mezirow's original work identified ten stages of perspective transformation. However, the transformation process can be summarized into three major elements: (1) critical reflection on assumptions; (2) use of empirical evidence or critical discourse to explore the assumptions; and (3) take action aligned with the transformed perspective [8].

The workshop examined in this study was not deliberately designed to foster perspective transformation. However, the participants are expert learners being presented with innovative ideas that challenge the typical teaching practice. Therefore, it was expected that they would critically examine these ideas in light of their teaching experience and knowledge. Moreover, they were presented with the notion of scholarly teaching as an evidence-based practice; i.e., a perspective supported by empirical evidence. Similarly, the discussion spaces built into the workshop became the venues for critical discussion and discourse. Transformative learning seems to have occurred, spurred by a challenging idea, critical reflection on teaching practice, exposure to relevant research outcomes, and negotiation through participants' discourse about the values and meaning they associate with teaching.

2.3 Assessment of professional development programs

There is abundant information on the evaluation of professional development programs (PDP). Most of the scholarly literature on the assessment of PDP draws upon the works of Donald Kirkpatrick and Thomas Guskey. In the late 50s, Kirkpatrick developed an employee-training assessment strategy from a managerial perspective and aligned with the needs of growing corporate America [9].

Three decades later, Guskey and Sparks [10] advanced a model for staff development that included four factors and their interactions: program content, program quality, organizational climate, and improvement in learning outcomes. Building upon Kirkpatrick's strategy and his own work, Guskey [11] advanced a model for the assessment of faculty PDP that included four distinct levels: (1) participants' reactions; (2) new knowledge and skills participants gained; (3) influence of new knowledge in participants' professional practice; and (4) increase in productivity, measured on the basis of students' achievements. Later, Guskey saw the need to add a new level that accounted for the organizational support faculty encountered when trying to implement educational innovations [12]. The revised model has five levels, as depicted in Fig. 1, and is known as the Critical Levels of Professional Development (CLPD). Although independently observable, each level builds on the previous one. In other words, success at a particular level is arguably required for success at higher levels.

Instruments intended to assess faculty development workshops and courses usually draw upon the CLPD model. For instance, the Ohio State University created a multi-level survey based on this model to evaluate their faculty development program known as ABLE [14]. Similarly, author Ortega-Alvarez used the CLPD model to inform the design of the assessment instrument to evaluate an ongoing NSF-funded project aimed at building knowledge exchange and co-construction between scholars in a research collaboration network. In the present study, the authors designed an assessment instrument for their instructional design workshop based on the ABLE assessment survey, explicitly aimed at levels one and two of Guskey's model. In addition, the responses to open-ended questions allowed a glimpse of levels three and four.

The assessment of transformative learning experiences has also been amply documented in scholarly literature [15]. Transformative learning

provides a lens to explore the experience of adult learners in general [8], but also has informed the study of the experiences of teachers as learners. Most of the work drawing from the transformative learning framework that has been applied to teachers and faculty development programs deals with the design and description of learning experiences. Studies aimed at determining whether a learning experience fostered perspective transformation frequently use the Learning Activities Survey (LAS) developed by King [16]. If transformation has occurred, the LAS aims to identify the activities that contributed to this outcome [7, p. 14]. The LAS is a comprehensive instrument that usually requires administering a four-step survey and conducting follow-up interviews, although it has been adapted and simplified for specific research projects [7, Ch. 13]. For instance, Caruana and colleagues adapted the LAS to examine the perspective transformation of participants in two graduate courses for pre-service teachers [17].

Other scholars have created their own instruments to assess educators' learning experiences based on the ideas of transformative learning. For instance, Kitchenham [18] used transformative learning to describe the experiences of ten school teachers as they learned to adopt educational technology in their classrooms. His findings suggest that "teachers do experience perspective transformations as they learn to use, adopt, and teach educational technology." [18, p. 222]. Similarly, Goulet [19] described the application of transformative learning in informal instruction contexts. Exploring the intersection of transformative learning and assessment, Goulet draws two main conclusions: (1) formative assessment may lead to perspective transformation, and (2) transformative learning is better fostered and captured by self-assessment. In this study, Goulet's conclusions were crucial for the design of instruments intended to assess transformative experiences.

With this context in mind, the research question driving this work was: How can one assess the transformative learning of engineering faculty about instructional design? This research question could be phrased in a more general sense: What is a sound way to assess the impact of professional development programs aimed at helping engineering faculty use the findings of educational research to inform their teaching practice? The relevance of this question lies in the need to design PDP that effectively help engineering faculty conceive of their teaching role in a scholarly way, and advance their teaching practice through evidence-based, innovative practices. Without proper assessment and reliable feedback, PDP may fail to change faculty's perspectives of teaching.

Fig. 1. Critical Levels of Professional Development (Adapted from [13]).

3. Methods

3.1 Participants and procedures

Twenty-three Colombian engineering faculty voluntarily participated in the 2016 offering of the twenty-hour workshop on instructional design. The participants had diverse backgrounds in engineering disciplines and experience as faculty members. The average time working as a faculty member was 11.7 years, ranging from 0.5 to 25 years. Their areas of expertise included mechanical engineering, process engineering, product design engineering, production engineering, and systems (computer) engineering. The workshop was conducted in Spanish and the instructors were native speakers. However, most readings and class materials were provided in English to help participants familiarize themselves with the terminology used in engineering education literature.

The workshop took place on five consecutive days with two sessions of 110 minutes per day, as shown in Fig. 2. As discussed earlier, the workshop was constructed and delivered based on the ideas of backwards design (i.e., alignment between content, assessment, and pedagogy). In addition, the workshop included an introduction to engineering education research on the first day, and participants' presentations of their design or redesign projects were scheduled on the final day.

The learning outcomes stated that after the workshop participants should be able to:

LO1. Write learning objectives appropriate for the dimensions and levels of knowledge of the curricular priorities of a course.

LO2. Design instructional experiences for an innovative class based on the techniques discussed in this course, using a topic and a method of your interest.

LO3. Critique the soundness, suitability, and outcomes of hypothetical and real implementations of innovative teaching methods according to their stated aims.

LO4. Document educational innovations thoroughly so they might be able to be published in engineering education conferences or journals.

Before and after the workshop, the participants completed surveys in Spanish aimed at identifying changes in their perceived understanding of, competence in, and interest in instructional design. Participants were presented with five pre-workshop and six post-workshop Likert-type questions with five levels. English translations of these items are presented below along with the constructs they intended to explore (in square brackets):

Please indicate your level of agreement regarding the following statements from one (strongly disagree) to five (strongly agree):

(a) *I have the ability to perform my duties as an engineering faculty in this institution. [competence]*

(b) *I have the required competencies to design courses appropriately. [competence]*

(c) *I feel motivated to improve my courses. [interest]*

(d) *I have the required competencies to conduct educational research. [competence—educational research]*

(e) *I feel motivated to conduct educational research. [interest—educational research]*

(f) *This workshop reinforces my abilities as an instructional designer. [competence, post-workshop only]*

The post-workshop instrument also included three open-ended questions, which, translated into English, read as follows: *(1) Please describe the most relevant aspects of this workshop and how you will use them in your future teaching practice [understanding]; (2) Please provide any additional comments you may consider relevant; and (3) Please describe what opportunities you see for improving this workshop.* The procedures and instruments for data collection were granted exemption by Purdue's
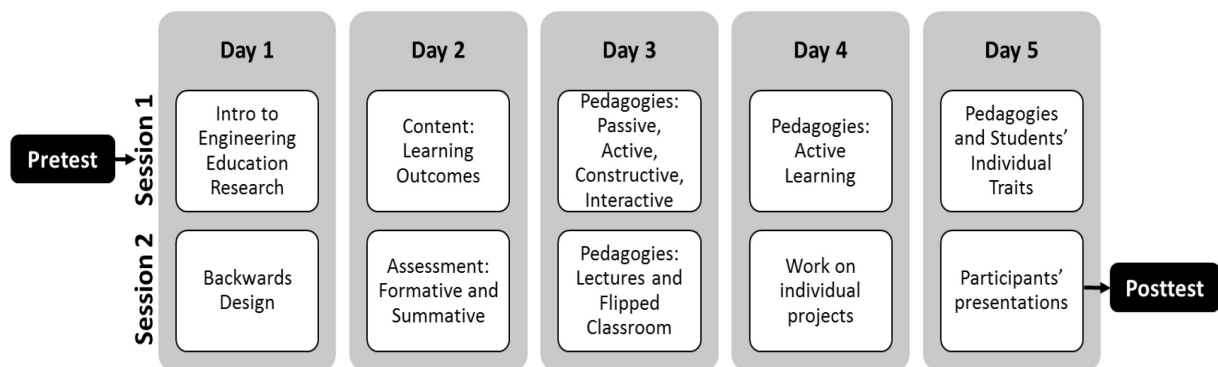

Fig. 2. Workshop activities and data collection procedure.

Table 1. Characteristics of the four offerings of the workshop

	University A 2016	University A 2017	University B 2017	University C 2017
Type of institution where the workshop was offered	Private	Private	Public	Public
Institution size (number of undergraduate engineering students)	Medium (~3.300)	Medium (~3.300)	Large (~7.000)	Medium (~5.300)
Total workshop participants	23	18	28	14
Participants' average years of experience teaching	11.7 (Min. 0.5; Max. 25)	13.7 (Min. 1.5, Max 35)	9.8 (Min. 0.5; Max. 42)	12.4 (Min. 0; Max. 35)
Participants who completed pre survey (& post survey)	18 (15)	18 (2)	27 (13)	14 (6)

Institutional Review Board (IRB) under the protocol #1605017685.

The workshop was offered again at three Colombian institutions in 2017. Table 1 presents some relevant characteristics of each offering. The design of the workshop remained, for the most part, unchanged from the 2016 offering. However, some readings and activities were adjusted according to the lessons learned regarding time management and participants' interests. Similarly, the workshop assessment instrument was slightly modified to explore the possible perspective transformation suggested by the assessment results of the 2016 offering. Namely, two open-ended questions were included, one in the pre-workshop survey and one in the post-workshop. Translated into English, these questions respectively read as follows: *(1) In your view, what does teaching entail? [perspective] (2) Has your view of teaching changed? Please elaborate [perspective transformation].* Research access to the data collected during the second round of offerings of the workshop was approved by Purdue's IRB under the protocol #1801020111.

3.2 Data analysis

The research team first analyzed the quantitative Likert-type items of the 2016 workshop looking at the distribution of participants' responses to each of them. Eighteen participants answered the pre-workshop survey, and fifteen participants completed the post-workshop. Given the scale nature of the data, the Wilcoxon signed-rank test was used to explore significant differences among the distribution of participants' responses to each question between the pre- and the post-workshop surveys [20].

Participants' responses to the open-ended questions were qualitatively coded independently by three researchers who are native speakers of Spanish. The three researchers were involved in both the design of the workshop and the survey instruments. After completing this open coding process, the three researchers met to compare their resulting codes and themes. The discrepancies that were found among the codes were negotiated until complete agreement was reached.

Later on, the Likert-type scale data collected during the 2017 workshops was examined using the same quantitative analysis procedure. For the qualitative portion, the authors focused on analyzing participants' answers to the added open-ended questions regarding their conception of the teaching role, and how this conception changed after the workshop. Two authors examined these responses independently and then shared their conclusions with each other. Following this procedure, these two authors were able to characterize the change underlying most participants' responses.

4. Findings

4.1 2016 Workshop—Incremental learning and hints to transformative learning

The analysis of the quantitative data from the 2016 surveys' pre- and post-workshop Likert-type items yielded unexpected results about participants' perceptions of their instructional design abilities. Fig. 3 depicts the distribution of participants' level of agreement with statement *b* on the pre- and post-workshop survey: *I have the required competencies to design courses appropriately.* This item is particularly important because it is directly connected to the overarching goal of the workshop. The Wilcoxon signed-rank test did not show any significant difference in the distribution of responses between the pre-workshop and post-workshop responses. However, looking at the individual responses, only one of the participants shifted their perceptions from level 2 (i.e., disagree) to a higher level, while two of the participants shifted from level 5 (i.e., strongly agree) to a lower level and the rest reported no change. Similar patterns were identified in most of the other Likert-type items between pre-workshop and post-workshop surveys.

Responses to the open-ended questions portrayed a more favorable perception of the workshop and its impact. In the 2016 workshop, three major themes emerged when the research team examine responses to the questions (a) what aspects of the workshop participants found most relevant, and (b) how they would use those aspects in their future

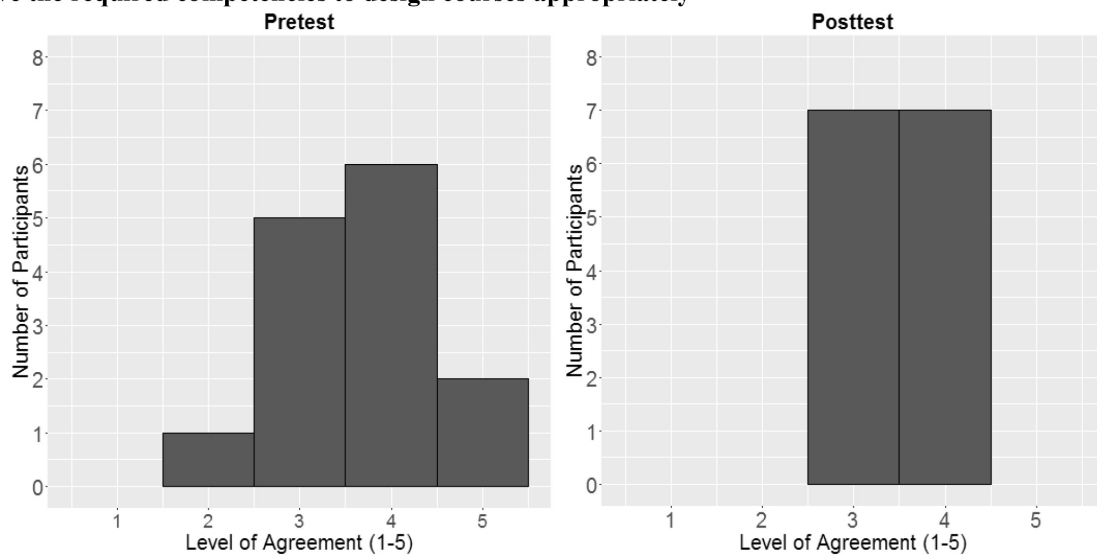**I have the required competencies to design courses appropriately**

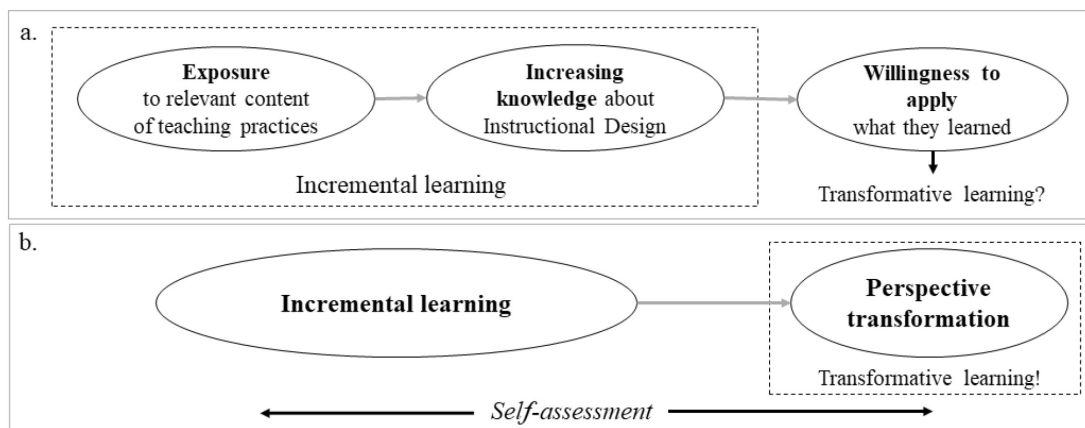Fig. 3. Distribution of responses to pre- and post-survey item b, 2016 workshop.

Fig. 4. Structure of themes identified in participants' responses in 2016 (pane a) and 2017 (pane b).

teaching practice. These themes were: (1) exposure to relevant content of teaching practices; (2) increased knowledge about instructional design; and (3) willingness to apply what they learned. Fig. 4a depicts the relationships between these themes and the hypothesized shift from incremental to transformative learning. Each theme is presented below with the number of participants whose comments aligned with it. Some exemplary comments excerpted from the survey accompany the themes. The authors translated these comments from Spanish to English reproducing the general meaning of the comment.

Theme 1: Exposure to relevant content of teaching practices (8 participants)

Comments aligned with this theme recognized the value of being exposed to research-based teaching practices. This theme relates to the second key element of perspective transformation: gathering

evidence through research and discourse. An exemplary quote for this theme versed as follows:

> "The approach to the topics presented, even if just becoming aware of the diversity of findings and ideas that can contribute to the teaching practice, I consider it to be a great lesson."

Finding applicable resources was the most relevant part of the workshop for another participant:

> "Having the opportunity to see different pedagogical tools in the course and some theories of teaching and learning. The former helps me implement some of them in my courses (trying to improve the understanding of some complex concepts), and the latter to write better papers about pedagogical practices."

Participants also made explicit reference to the relevance of being exposed to educational research. One participant assessed that the workshop was useful to:

> "Allow me to become acquainted with a view of

educational research along with good material that could be applied to our classrooms."

In sum, this theme describes how participants articulated a new discourse as a result of the exposure to the new paradigm being presented to them. Moreover, they started to provide hints of possible application to their duties as faculty.

Theme 2: Increasing knowledge about Instructional Design (6 participants)

Quotes aligned with this theme made specific reference to the participants' motivation to reflect on their current practices, and how these practices could be improved based on the evidence presented. One participant expressed:

> "This workshop allowed me to see the teaching-learning process in an integral way and reflect on my teaching process, and how it can be modified so a higher number of students can understand the class topics in a more effective way."

Similarly, another participant indicated:

> "I believe that understanding backwards design and improving the formulation of [learning] objectives and ways to assess student learning, as well as understanding a little bit more about different learning styles of the students, makes me reflect."

Some participants reported reflecting on the relevance of the topics covered in the course. In particular, many participants expressed how the workshop allowed them to reflect on their current teaching practices, making potential space for their improvement. A participant expressed:

> "Excellent workshop, I think it is really necessary to make us think about how to improve our courses."

Critical reflection is the key element that triggers transformative learning experiences. As exemplified by the previous quotes, participants explicitly expressed how the workshop content and activities ignited their thought and, possibly, critical reflection.

Theme 3: Willingness to apply what they learned (4 participants)

According to Mezirow [8], a truly transformative learning experience would derive in learners taking action in accordance with their transformed perspective. This willingness to apply what they learned was the third theme identified in the participants' comments. A quote aligned with this theme versed:

> "I particularly liked the concept of flipped classroom (in combination with other tools), and I will seek to apply it."

When referring to specific things they would try, a participant referenced:

> "Based on this [workshop], I will update learning objectives, educational material, and assessments."

Although no action has yet been documented, this theme speaks to the planning of a course of action. At this point, the learner has internalized the value of the materials presented and has assessed that their adoption would represent a benefit for their practices [6].

Analyzed together, the Likert-type data and the open-ended responses revealed a discrepancy between the poor results suggested by the quantitative assessment and the positive qualitative feedback received from the participants. In light of this discrepancy, the research team hypothesized that the workshop was a transformative experience that prompted participants to change their perception of what is needed to design effective courses. In other words, some of the participants might have felt underprepared for instructional design after learning what this task entails. Furthermore, it is reasonable to posit that the workshop transcended incremental learning and became a transformative learning experience. The 2017 offering of the workshop provided an opportunity to test elements for the assessment of transformative learning discussed in Section 2.

4.2 2017 Workshop—capturing transformative learning

In contrast with participants' quantitative assessment of the impact of the 2016 workshop on their ability to design courses, participants in the 2017 offering actually reported an improvement, although, again, it was not statistically significant according to the Wilcoxon signed-rank test. As shown in Fig. 5, eleven participants answered question b in both the pre- and the post-survey. Three participants shifted their perception from Levels 1 and 2 to higher levels, and two participants shifted to level 5 (the highest).

As mentioned in the Participants and Procedures section, the 2017 instrument included an additional pre/post-survey question. The authors included this question to provide an opportunity for self-assessment, drawing from the elements for assessing transformative learning proposed by Goulet [19]. Specifically, the authors added the pre-workshop question "*In your view, what does teaching entail?*" paired with the post-workshop question "*Has your view of teaching changed? Please elaborate*". Overall, 18 participants from the three 2017 workshops responded to both the pre- and post-workshop additional question. Qualitative analysis of participants' responses resulted in two themes illustrated in Fig. 4b. Seven out of the 18 paired responses depicted incremental learning as a result of the
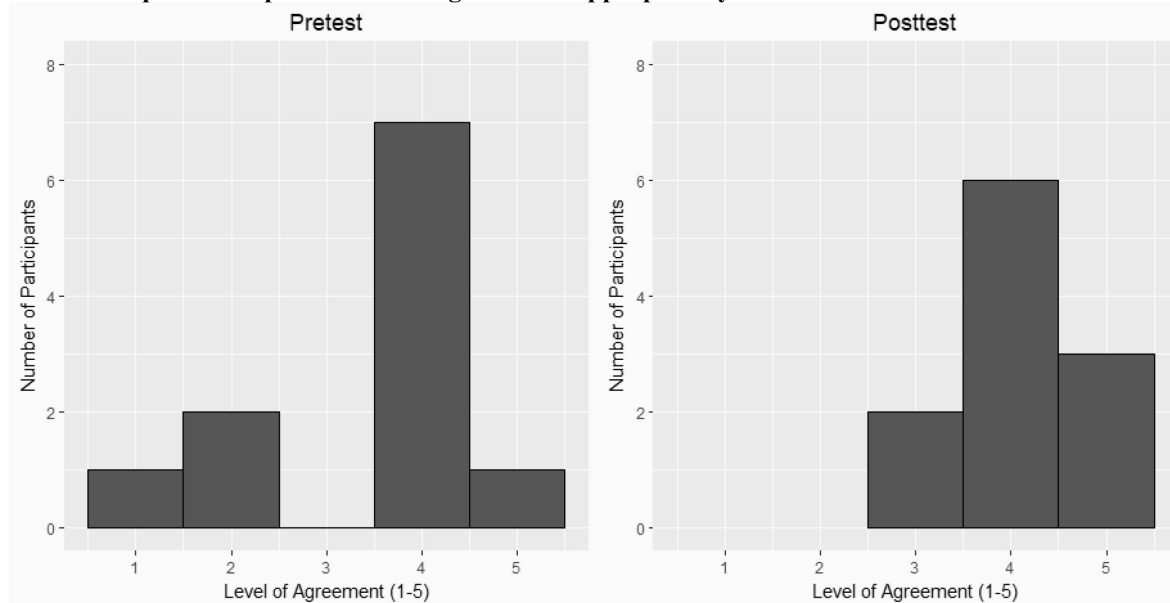
I have the required competencies to design courses appropriately

Fig. 5. Distribution of responses to pre- and post-survey item b, 2017 workshops.

workshop, and the remaining eleven responses established a recurring change in participants' conceptions of their role as teachers. The first theme, incremental learning, can be directly mapped to the first two themes presented in section 4.1 (i.e., exposure to relevant content of teaching practices and increasing knowledge about instructional design). The second theme offered tangible evidence of the perspective transformation only hinted at from the assessment of the 2016 workshop. Moreover, the comments related to this theme suggest a very specific change in perspective: a shift from a teacher- to a student-centered view of teaching. The following comments, translated by the authors, illustrate both themes.

Incremental learning about teaching and learning (7 participants)

As opposed to transformative learning, incremental learning does not entail a change in participants' conceptions of teaching. Rather, it encompasses the adoption or adaption of practices that faculty found useful to improve their teaching practice. For instance, the following participant reported the acquisition of strategies for content delivery that goes beyond lectures without a transformed perspective of teaching as merely knowledge transfer:

Pre: *Training [teaching], research, lecturing, identification of learning difficulties, course design.*
Post: *Yes. I realized that teaching is more than standing up by a blackboard to impart knowledge. And that there are more methods to transfer information.*

Within this theme of incremental learning, a particularly recurring idea, and certainly one worth exploring in future work, is that of continuous self-assessment and improvement as a duty of faculty in their teaching role. Two participants suggested that course improvement goes hand in hand with self-assessment:

Pre: *Planning and updating curricula. Planning, preparing and updating courses: content selection, content delivery, creation of projects and assessment activities. Advising students.*
Post: *This workshop has made evident the need for a continuous process of self-assessment and course improvement and the results from educational research provide a good starting point to that aim.*
Pre: *Class preparation. Class development. Research activities in and out of the classroom.*
Post: *Yes the perception has changed, because there was evidence of better practices to embrace the pedagogical process in the university. Just understanding that the curriculum is not static lead us to permanent changes in our actions as teachers.*

According to these comments, the workshop accomplished its mission of disseminating evidence-based practices that participants found useful and relevant for improving their teaching skills. However, this theme does not provide explicit signs of a transformation of the notion of teaching per se.

Perspective transformation (11 participants)

In most of their responses, participants explicitly

mentioned how their revised perspective of teaching has the student at the center of the process. In some cases, the responses evidenced a drastic change from a traditional view where the focus is on the teacher's responsibilities:

> **Pre:** *Adoption of a curriculum, interpretation of the curriculum, class preparation, implementation of the didactic tools available, assessment, feedback, improvement of these [previous] activities.*
> **Post:** *Yes, I have comprehended what student-centered learning entails.*

As expected, participants had different levels of experience with educational research but they all had a genuine interest in improving their teaching practice. For instance, some participants came to the workshop already having student learning at the top of their priorities, but still found room for improvement. For instance, the following participant was familiar with classroom research as a means to assess the efficacy of educational interventions even before the workshop:

> **Pre:** *Curricular design, design and selection of pedagogical mediations, design and selection of teaching-learning methods, classroom research on the efficacy and efficiency of assessment methods.*
> **Post:** *Focus much more on students' goals and focus course design on it.*

Similarly, another participant had already a sense of keeping student outcomes as the aims of the pedagogy and assessment design:

> **Pre:** *Research, design, and preparation of contents and assessment focused on reinforcing students' competencies.*
> **Post:** *Yes, it is better to design environments where students are protagonists and generate knowledge.*

Finally, some participants where less explicit in mentioning a student-centered perspective, but were clear about facilitating student learning, not simply delivering content, as their actual role as teachers:

> **Pre:** *1. Teaching and knowledge transfer to the students. 2. Research. 3. Service projects.*
> **Post:** *Of course, I think that teaching practice goes beyond imparting topics in a lecture, it goes from the very conception of a course thinking on the students to the execution of active learning experiences designed so they [the students] can understand a topic better.*

To summarize, eleven workshop participants reported shifting to a student-centered conception of teaching, although not all of them started from the same place. Whereas some of them started from a traditional, teacher-centered conception of teaching, others found themselves already in a transition state [21]. On the other hand, seven participants found the experience informative and reported some incremental learning from it, without explicit references to a change in perspective.

5. Discussion

This work was motivated by the question: *How can one assess the transformative learning of engineering faculty about instructional design?* The findings of this study, summarized in Fig. 4, suggest that traditional assessment techniques, like pre/post questions and surveys, can adequately capture incremental learning that has occurred as a result of PDP. However, open-ended questions may allow a more nuanced view of the characteristics of this learning. For instance, participants in the 2016 workshop described in this study reported gaining knowledge of tools and tactics previously unknown to them, and expanded notions of teaching and learning as the most relevant outcomes. In other words, they attested to the success of the workshop in fostering incremental learning and sparking an initial reflection about teaching. This reflection, along with the willingness to apply the new knowledge into their practice, was consistent with two of the three major elements of transformative learning: critical reflection and action aligned with the new perspective [8]. However, in light of these findings, claims to perspective transformation seemed more conjectures than evidence-based arguments.

The deliberate inclusion of prompts for self-assessment in the survey of the 2017 workshop, as suggested by Goulet [19], allowed the assessment instrument to capture and characterize a change in participants' conception of their teaching role [22]. The authors believe that this question made participants reflect not only on their role as teachers, but also on how well-equipped they were to fulfill this role. Moreover, the reiteration of the question after the workshop might have helped participants perceive their increased awareness about good teaching practices as a gain, even if that implied that their pre-workshop assessment was skewed. In other words, the question might have helped participants become aware that the perspective transformation occurred, which they subsequently deemed as a gain. The qualitative evidence collected through this strategy allowed the authors to characterize the change in perspective as a shift from a teacher- to a student-centered view of teaching. Furthermore, it can be argued that including self-assessment prompts not

only allowed capturing perspective transformation but actually fostered it.

Examined together, the evidence from 2016 and 2017 suggests that the workshops accomplished their initial goal of facilitating diffusion of evidence-based practices and participants' incremental learning of instructional innovative ideas and skills. On the other hand, the perspective transformation, hinted in 2016 and better captured in 2017, resulted as an unexpected outcome that the authors celebrate. At this critical time when the Scholarship of Teaching and Learning is gaining strength, the challenge is to identify design elements that facilitate the creation of faculty PDP that deliberately foster participants' perspective transformation toward student-centered conceptions of teaching. A key first step in identifying such design elements, as suggested by this study, is the appropriate design of assessment instruments aligned with the tenets of transformative learning.

The results of this work provide further support for a well-known conception: Instructors must look carefully at what kind of learning is happening in their interventions and choose the correct assessment measures accordingly. In fact, some scholars have advanced strategies to align assessment with the particulars of the learning taking place in specific settings [23]. The authors believe that applying these strategies, while considering the tenets of transformative learning, could lead to the design of more appropriate instruments to assess faculty development. Therefore, future work will be directed towards the design and testing of such instruments.

The authors recognize that it would be valuable to explore the differences in participants' experienced transformation that can be related to demographic variables (e.g., teaching experience, gender, age, and academic experience). However, the small sample size of each subgroup within the diverse group of participants was a limiting factor that delayed such an analysis. This analysis will take place as the cumulative number of participants in these workshops increase.

6. Conclusions

The focus of this study was the discussion of the particularities of assessing transformative learning experiences. Transformative learning can be fostered by courses and workshops aimed at helping faculty use educational research to improve their teaching practice. This was found to be the case in a series of workshops the authors offered to four groups of engineering faculty at three Colombian public and private universities. A first survey designed to assess the effectiveness of the workshop yielded contradicting results. On the one hand, the self-reported perception of gain in skills measured through pre-post Likert-type items showed no change, and sometimes a non-significant decrease. On the other hand, stories of positive transformation were present in much of the qualitative data gathered from responses to open-ended questions. The research team hypothesized that participants' views of what is comprised by instructional design were expanded and transformed, and participants might have realized that they had overestimated their knowledge about it in the pre-survey.

To fully capture this hypothesized transformation, during the most recent offerings of the workshop the research team modified the survey to include self-assessment, a key element in the assessment of transformative learning [19]. Results derived from the modified survey allowed the authors to corroborate their hypothesis: Beyond the expected incremental learning, the workshop fostered perspective transformation, and the initial assessment survey was not appropriately designed to capture it. These results suggest that the design of an effective and appropriate assessment instrument to capture perspective transformation should draw upon the key elements of transformative learning: (1) critical reflection on assumptions, (2) exploration of assumptions, and (3) action aligned with the new perspective. Moreover, it should include self-assessment and formative assessment as key elements to foster these elements [19]. In turn, the design of faculty development workshops that deliberately foster perspective transformation can be informed and improved by insightful assessment results.

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