Board 45: A mandatory early internship course: An analysis of engineering identity of students.

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A mandatory early internship course: an analysis on engineering identity of students.

Abstract

According to the literature, engineering identity significantly affects motivation and retention among students, and engagement and involvement in the industry seem crucial in attaining such identity.

For this evidence-based paper, we report the experience of a new mandatory early internship course in industrial engineering programs at a large private university. In 2020 the Universidad Andres Bello School of Engineering significantly changed its curricula. One of the most significant changes was the redesign of internships to address observations made by peers during previous accreditation processes that pointed out the lack of supervision and guidance during students' internships. Thus, we designed a mandatory internship course to complement and enhance students' experience before and during their first approach to the working world through mentorship and webinars that intend to support the role and identity of future engineers. For one term, students from the program's second year participated in initiatives with the industry, attending webinars with high executives and recognizing people from the public and private sectors. That presented them with several areas where they could perform their profession and the challenges for their future engineering role. Also, they participate in small groups with a teacher who guides them before and during their internship to better give them tools to introduce them to the opportunities available in the industry and empower them as engineers.

Consequently, this paper intends to assess the impact of these new redesign courses on students' engineering identity. We collected data through a validated survey from three different samples of students currently enrolled in Industrial Engineering programs to evaluate whether these groups have significant differences regarding their engineering identity. The first group included students presently going through the mandatory early internship course. The second group involved students at the end of their first year who had not yet gone through this class. The final group included third-year students that went through the former model of internships, without mentorship or course associated, used as a control group. We found significant differences between one of the items that would impact students' engineering identity.

Keywords

Internship; Engineer Identity; Mentorship; Industry.

Introduction

In 2020 a significant change in the curricula began its implementation in the Engineering Faculty of a large private university in Chile. The changes involved the two existing programs for industrial engineers: four- and five-year programs with differences in focus; four-years engineers emphasize operational aspects of the industry, while five-year engineers prepare for a leading role. Mainly, the new curricula included actualized contents, more practical approaches for the student's learning experience, and new courses focused on current industry requirements. Still, one of the most challenging changes was regarding internships.

In the previous curricula, students had two mandatory internships as part of their program: one, known as "Early Internship," required students to perform as interns inside an organization for a minimum of 180 or 360 working hours, depending on their program, Students were required to have finished all mandatory first- and second-year courses to be allowed as early interns. The second internship, known as the "Professional Internship," required a minimum of 360 working hours in both programs, which could start a year before the end of the program.

The student searched for their internship, and there were mainly two control points: the first was the registration before the start of the training, which involved a form describing proposed functions for the intern, signed by the industry's supervisor. At that point, it was also verified that the student approved enough courses to ensure a minimum knowledge level to allow a good performance as an intern. At the end of the internship, students were required to deliver a full report of their experience and observation made inside the organization, which often was rejected and required several corrections overdue. Furthermore, during accreditation processes, peers emphasized the lack of supervision during the internship period as a significant weakness to overcome in the future and the fact that no previous guidance was given to students to prepare them for a proper insertion in the working world. Another major issue with early internships in these curricula was that even if there was a requirement of a minimum of mandatory courses approved before registration since the internship was not required for later classes, most students tended to delay this internship and search for only one long professional internship at the end of their program. Thus, the objective of an early internship was lost, and many of the students made only one long 540- or 720-hours internship instead of the two the curricula intended.

A new internship course was designed with a novel approach to address those concerns. First, a teacher was assigned for every fifteen students. The teacher's role was designed to act as a mentor that intended to smooth the students' path into the industry and to have a closer look into the student performance during the internship. The mentor was required to contact the industry's supervisor and gather information to help close the gaps the student might have. The hope is to build long-lasting relationships with the organization to benefit current and future interns and the engineering faculty. This new course was inserted during the last term of the second year and involved regular weekly classes, plus the industry component of the internship that is mainly due during summer vacation. However, mentors are not in charge of every course: mostly, students attend mandatory webinars given by prominent public and private sector personalities that enlighten the role and future challenges for the industrial engineer in the years to come, favoring engineering identity [1] [2].

In the literature, engineering identity significantly affects motivation and retention among students, and engagement and involvement in the industry seem crucial in attaining such identity [1], [2]. Also, professional identity in engineering has been presented as a principal element in career development. Frequently identity is related to the retention construct [2], depending on initial motivation to select a specific engineering program, persistence during the career, and a successful career in the industry. Regarding initial motivation, engineering and STEM identity in elementary students can positively influence the perseverance to get a degree [3]. However, engineering programs also can affect the professional identity of their students over the previous motivation for the program selection. E.g., in Burleson et al. study [4], a link between the change in professional identity was positively related to persistence and embeddedness. Both constructs have been associated with the permanence of people in their jobs and occupations, presenting an alternative to the classic retention approach [5].

Consequently, this paper aims to answer the following research question: How does this new redesign course impact students' engineering identity?

Methodology

Participants

The sample consisted of 131 students enrolled in Industrial Engineering programs. Participation in the study was completely voluntary. These students were classified according to their characteristics:

- Group 1: students currently going through the mandatory early internship course
- Group 2: students at the end of their first year who had not yet gone through an early internship course.
- Group 3: third-year students that went through the former model of internships without mentorship or course associated (control group).

Table 1 shows the composition of the sample.

Table 1: Composition of the sample

Group	Sample Size (n)
Group 1	16
Group 2	101

Group 3	14
Total	131

Procedure

To assess the impact of these new redesign courses on students' engineering identity, we define a questionnaire of 14 Likert-scale items. This questionnaire is based on Bahnson et al. [6]. This work focuses on graduate engineering identity variability during the career, influential by discipline, gender, and other variables. Each item has five options regarding an agreement with the presented affirmation using categories: 5 = Strongly agree, 4 = In agree, 3 = Neither agree nor disagree, 2 = In disagreement, 1 = Strongly disagree. Table 2 presents the instrument's question list.

Table 2: Instrument's questions list.

Item number	Affirmation text
1.	I see myself as an engineer.
2.	My career authorities see me as an engineer
3	I have had experiences in which I have been recognized as an engineer
4.	Others ask me for help with engineering issues
5.	I want to be recognized for my contributions to engineering
6.	My teachers see me as an engineer
7.	Other engineers see me as an engineer
8.	I find satisfaction when doing engineering activities
9.	I enjoy learning about engineering
10.	I am confident that I can understand engineering in class
11.	I am confident that I can understand engineering outside of class
12.	I can perform well when my engineering knowledge is tested
13.	I understand the concepts I have studied in engineering
14.	I am confident that I can apply engineering to solve problems

Instruments and data collection

Data analysis was performed using SPSS 14.0 and GraphPad Prism 9.5.0. Answers were coded using an ordinal nomenclature to perform statistical analysis, as previously presented. Then, the instrument's reliability was calculated using Cronbach's alpha. Obtained Cronbach's alpha value was 0.94 (high reliability).

Results

To answer the research question, how do these new redesign courses impact students' engineering identity? The three groups were compared doing a nonparametric Kruskal-Wallis Test on Likert-scale item results and a nonparametric Mann-Whitney test to compare Pairs

Group 1 v/s Group 3 (control), and Group 2 v/s Group 3 (control). Table 4 shows that the Kruskal-Wallis test showed no statistically significant difference in all questions between the different groups.

Regarding the nonparametric Mann-Whitney test between pairs of groups, results are presented in Table 5 and Table 6. This test showed a statistically significant difference in Question 4 score between Group 1 and Group 3 (control), $p = 0.025$, with a mean rank Question 4 score of 12.31 for Group 1 and 19.14 for Group 2 (control). Figure 1 and Table 7 show the distribution of the answers for Question 4.

Table 4: Nonparametric analysis between three groups.

Test Statistics[a,b]

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Quiestion 8	Question 9	Question 10	Question 11	Question 12	Question 13	Question 14
Chi-Square	.442	.399	1.941	5.224	1.933	.500	.653	.317	.012	.040	.044	.390	.275	1.684
df	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Asymp. Sig.	.802	.819	.379	.073	.380	.779	.722	.853	.994	.980	.978	.823	.872	.431

a. Kruskal Wallis Test

b. Grouping Variable: Group

Table 5: Comparison between Group 1 and Group 3 (control)

Test Statistics[b]

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12	Question 13	Question 14
Mann-Whitney U	99.500	100.000	92.000	61.000	83.000	110.500	97.000	107.000	110.000	109.500	108.000	111.500	107.000	96.000
Wilcoxon W	235.500	205.000	228.000	197.000	219.000	246.500	233.000	243.000	215.000	245.500	244.000	247.500	243.000	201.000
Z	-.571	-.535	-.879	-2.242	-1.350	-.065	-.646	-.221	-.091	-.113	-.178	-.022	-.221	-.727
Asymp. Sig. (2-tailed)	.568	.593	.380	.025	.177	.948	.518	.825	.928	.910	.858	.982	.825	.467
Exact Sig. [2*(1-tailed Sig.)]	.608[a]	.637[a]	.423[a]	.034[a]	.240[a]	.951[a]	.552[a]	.854[a]	.951[a]	.918[a]	.886[a]	.984[a]	.854[a]	.525[a]

a. Not corrected for ties.

b. Grouping Variable: Group

Table 6: Comparison between Group 2 and Group 4 (control)

Test Statistics[a]

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12	Question 13	Question 14
Mann-Whitney U	684.000	641.000	549.500	516.500	580.000	639.000	636.500	678.000	696.500	703.000	690.500	658.500	688.000	679.500
Wilcoxon W	5835.000	746.000	5700.500	5667.500	5731.000	5790.000	5787.500	783.000	801.500	5854.000	5841.500	763.500	793.000	5830.500
Z	-.218	-.604	-1.401	-1.736	-1.207	-.622	-.644	-.266	-.099	-.037	-.151	-.439	-.176	-.254
Asymp. Sig. (2-tailed)	.827	.546	.161	.083	.227	.534	.520	.790	.922	.970	.880	.661	.860	.800

a. Grouping Variable: Group

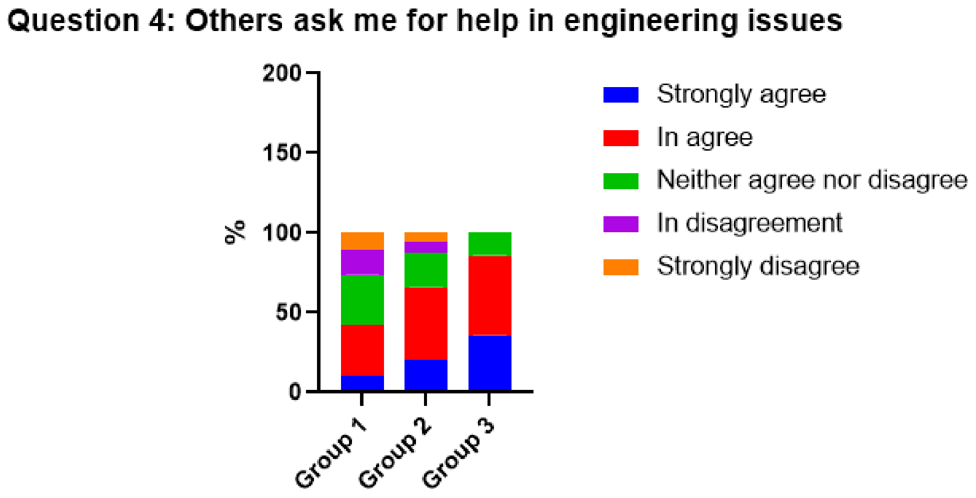

Figure 1: Answers for Question 4: “Others ask me for help in engineering issues”

Table 7: Answers distributions for Question 4: “Others ask me for help in engineering issues”

Group	Strongly agree	In agree	Neither agree nor disagree	In disagreement	Strongly disagree
Group 1	10.53%	31.58%	31.58%	15.79%	10.53%
Group 2	20.00%	45.71%	21.90%	6.67%	5.71%
Group 3	35.71%	50.00%	14.29%	0.00%	0.00%

Discussion

Regarding results, there are no differences between students currently going through the mandatory early internship course students at the end of their first year, who had not yet gone through this class, and the control group, composed of third-year students that went through the former model of internships, without mentorship or course associated. The exception was Question 4, “Others ask me for help in engineering issues,” comparing students with early internship courses with others with early internship without the presented intervention. From a descriptive statistical analysis of this item, there is more agreement with the proposed affirmation in the control group without disagreement. Ruling out sample-size bias, Group 1 presents a more uniform distribution, with a higher value for a neutral position. This fact is similar to the rest of the questions.

One of the principal limitations of the study is the small sample of Group 1 and Group 3 (control), which reduces the generalizability of the results. Conversely, the large size of group 2 was moderated using the proper statistical analysis (Kruskal-Wallis test). More large samples could improve the results, obtaining a representative view of early internships and their relationship with engineering identity.

Conclusions, Limitations, and Future Work

This work analyzed how an early internship course can develop engineering identity. Concerning the research question: how does this new redesign course impact students’ engineering identity? We found no significant impact on engineering identity compared with other groups. However, agreement with identity affirmations, asked by our instruments, is similar to the other groups. Also, an important fact is that group 3 (the control group) does not present disagreement with the affirmation, “Others ask me for help in engineering issues.” In this case, less-guided work in a classical internship, with more focused-on job needs and tasks, over mentoring and more integral professional development, could favor a more helper identity [7].

Regarding the projections, the results of this mandatory early internship course have been promising so far. Students manifest better knowledge of their future roles as engineers. They are thankful for mentorships that empower them to navigate and initiate their career path, making them feel motivated and engaged with the profession. A positive side effect is that we also observed better bases for long-term relationships with the industry. Their engagement in the course has also deepened and broadened the ties between them and the faculty. Then, it is interesting to analyze how an innovative internship course can power the engineering identity.