

# **Appreciative Inquiry to Promote Innovation Culture in Industrial Engineering Students**

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## **Abstract**

This research aims to determine how appreciative inquiry promoted the culture of innovation in an engineering school and based on the results that were obtained to propose a plan of activities. Appreciative inquiry took place in a school of industrial engineering at the university in northern Peru, where thirty-seven students participated. These students participated through interviews and surveys by inquiring them about the best of what they have done in order to imagine what could be. Then a survey is conducted to determine the student perception of corporate style about the industrial engineering program (IEP). Analyzing the data, the hypothesis is accepted: that appreciative inquiry has promoted the culture of innovation in the industrial engineering program. This can be evidenced in the participation in more academic events, meeting and courses, in national and international calls about innovation, etc. Results obtained by students forced to the IEP to a greater participation and involvement in a process towards a culture of innovation.

## **Keywords**

Appreciative inquiry, innovation, culture, engineering, industrial.

## **1. Introduction**

Universities have a close commitment to companies because they are an organization with greater management experience in the transfer of knowledge and technology to companies. It is a duty that the university has to share knowledge through its graduates, but its greatest responsibility is to motivate and stimulate a culture of change in its students, making known what they do, because the existence of good innovative ideas is evident, which are they reflect in the medium term, in new business opportunities, process or product improvement and business diversification.

When the university is present or absent from society, a space is created to generate positive or negative impacts on it, being competitiveness the most susceptible factor (Ruesga and Da Silva 2007). One of the critical components of innovation is the development of human talent, because they are the essence of the process (Peláez 2013), therefore professional training must be reoriented in such a way that it not only responds to the market need, with an added

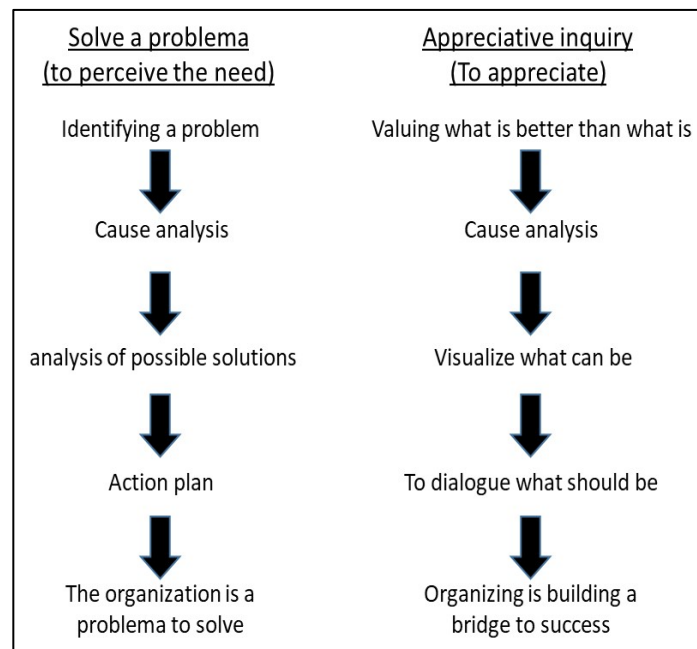
value that is not more than innovating to differentiate itself, but also in enhancing the creativity and skills of students and professionals to adapt to different environments and limitations. Peláez's study acquires greater relevance with the study carried out by the Spanish Association of Quality — AEC on the culture of innovation, where they state that people with their passion and commitment in generating new ideas are the axis main to contribute to the achievement of the competitiveness of companies and an innovative culture. Universities are not alien to this problem, to this perception of being guilty for the training of future professionals.

The environment and the increasingly sophisticated demands of society are creating new ways of working that require innovative ideas and continuous improvement of processes to contribute to the competitiveness so necessary for companies (Armstrong et al. 2020), (Ulloa et al. 2020). Then, the culture of innovation must be promoted in the training of students, without this meaning that academic rigor must be sacrificed, since there are teaching-learning strategies that would allow to achieve more and better academic performance in students, through motivation, generating positive attitudes, integration, etc. Such is the situation of the industrial engineering program at a university in northern Peru, that through open and high-level dialogue it was possible to collect concerns and criticisms of the management models in the training process, which made the students feel the program lacking in flexibility, motivation and initiative.

The dialogue outside the classroom made it possible to know the limited expectations they had about the program, but that on their own initiative of a few they looked to other similar institutions for the possibility of achieving better results. The students expressed desire and interest in being able to participate or carry out interesting and innovative academic activities that go beyond their regional borders and that could gradually enrich during the remaining time in their training, but that they saw it in an uncertain way. The ideas that some expressed were in themselves quite interesting and ingenious, but that they felt that there was not the support to take it to the next level, and the perception of lack of a school policy to listen and consider the ideas that were born in the students.

Most of the opinions and expressions were obtained from personal dialogue, when this dialogue took place in a group, there was a risk of repeating ideas or suggestions. Moreover, the opinions or suggestions that they provided in a particular way were enriching, since ideas of great interest could be obtained for a better management of the industrial engineering undergraduate program.

Figure 1. Appreciative interview



Source: Cooperrider, D., 2003

## 2. Literature review

Appreciative Inquiry (AI) is a method of inquiry and organizational development that is based on the following premise: if the study of a system alters the system itself, why not do it in such a way that it creates an attraction towards meaningful or successful experiences? Instead of asking what is going wrong, the AI method takes an alternative path and asks what is being done right? (Dewar et al. 2020). Appreciative inquiry is a process of collaborative search and organizational development, which involves the people who are the nucleus of an organization, that is, in their competencies, skills, talents and in their best practices enhancing it, renew it and improve its performance. It is a joint and integrated search for the best that exists in people and in their organizations (Varona 2007). The traditional and common thing (which does not mean that it is wrong) is to identify the weaknesses or errors to correct it, in the case of appreciative inquiry it seeks to generate better performance based on the strengths and abilities available to the staff, that is, that it seeks to improve performance as a result of positive examples based on the organization's past (Cooperrider 2003). In terms of learning, evidence indicates that when students are more positively, learning process is more effective (Guardia et al. 2019).

The culture of innovation is a set of assumptions, values and behaviors that allows a group of people, department, faculty or university to carry out innovations without major resistance. And this will be achieved as the corporate style develops, generating knowledge, supporting ideas and establishing good communication with its internal and external clients (Felizzola and Anzola 2017). Today the university is destined to change if it wants to continue being the institution that creates, criticizes and transmits knowledge for the development of society. It must, therefore, equip itself with an organizational culture predisposed to change.

Today the university is destined to change if it wants to continue being the institution that creates, criticizes and transmits knowledge for the development of society. It must, therefore, equip itself with an organizational culture predisposed to change (Harmon et. al. 2012). However, in order to adopt a culture of change, it is necessary for the university to adopt strategies that contribute to modifying the existing culture to turn it into a culture in which values and predominant behaviors are those of acceptance of change, interest to improve, etc. characteristics of an innovative culture (Tosati et al. 2015). The time we live in today is a time of successive and rapid changes, with difficulties to be able to integrate them. The knowledge-based economy, the quality agenda, the need for constant restructuring and the shift from teaching to learn are the driving forces behind university trends (Tómas et al. 2010).

The innovations that a university develops, unlike a company or industry, are new academic programs, new forms of teaching, new forms of cooperation and development, new organizational structures, new products or processes as research results, new forms of direction, management, and new courses. The corporate style is the main endogenous character that must be considered to establish a culture of innovation. The corporate style should promote creativity and communication, value the ideas of the staff and foster the profile of the entrepreneur (Tejeiro 2014).

## 3. Methodology

What appreciative inquiry seeks is to enthuse people to share their positive and successful experiences, because knowing what they liked, how they felt in the experience of achieving something, allows to awaken the positive that people have and affects creativity, and the positive attitude that is needed to face challenges or to adapt in such changing environments.

### 3.1 Appreciative interview

Techniques are the means used to collect information, and in this research interviews are used. In this case, the collection of information for the appreciative inquiry was carried out through semi-structured appreciative interviews (Fig. 2). The interview will seek to discover the appreciative potential of the students and based on this to be able to elaborate categories by similarity to determine a proposal for improvement.

Figure 2. Appreciative interview

**Appreciative interview**

Almost all professionals live at least five years in a university and almost always they have had one or more experiences in a subject that made them feel good and allowed them to improve or change what classic or traditional. Let's see, you take a trip back in time and locate that moment, now I ask you to:

1- Describe a positive experience of innovation (designing new products, prototypes, proposing new ideas, etc.) since you started your studies,  
- What happened?  
- Why was that experience good?  
- what factors made it a good experience?

The facts and situations that we live every day in the experience of being a student, always allow us to learn and enrich our life experience, just the fact of being surrounded every day and almost always with the same classmates solving exercises, applying theories, elaborating proposals, etc., makes the work team have successfully faced the demands of each subject, especially those that challenge creativity, ingenuity and where we want to surprise the teacher with an innovative, unique or spectacular design, right?

2- What do you value most about your experience in innovation? Why?  
- How did you contribute to the team?  
- How did you get them to consider your opinions or suggestions?

Many times during the process of creating, inventing or generating new ideas, a comment always appears like "if we had ... we would do better" Well, today you have a chance and your friend Harry Potter who came from Gryffindor has given you a magic wand:

3- Imagine that you have that magic wand and it allows you to fulfill three wishes regarding innovation. What are the three wishes to improve creativity and innovation in school to face the future?

The school always seeks to be at the forefront of content and trends, which allows us to update our training strategies:

4- How do you imagine the School if we organized it to promote creativity and innovation? Express it through phrases, qualifiers, drawings or diagrams.

**Closing interview**  
Would you like to suggest or comment something else about the interview?

### 3.2 Population and sample

The study population has been considered as the average number of students registered by the industrial engineering program in the last four years. The balance between the number of students who graduate and those who start their studies has been taken into account. The study sample was determined considering the size of the population enrolled in the fifth year, the error tolerance and the level of confidence:

$$n = \frac{Z^2 \sigma^2 N}{e^2 N - 1 + Z^2 \sigma^2}$$

### 3.3. Interview for corporative style

To measure the culture of innovation in the school of industrial engineering, a questionnaire is used that considers three indicators, questions that correspond to the corporate style with which the program of industrial engineering is management in relation to the perception about the culture of the innovation (Fig. 3).

Figure 3. Interview – Corporative style

Interview – Corporate style	
1. Are student or teacher projects promoted, giving them independence to move forward and participate in competitions?	
2. Are students or teacher recognized based on the contribution of ideas for improvement?	
3. Is there good informal communication between management or teachers and students?	

### 3.4 Phases of appreciative inquiry

The positive center of the organization can be recognized based on the processes developed when applying the 4 D. The 4 D's is a co-construction process that begins with a search and continues permanently as a continuous organizational learning process (Wolf 2017):

- a. **Discovering** (what the organization is): the primary task in this phase is to identify and appreciate the best of the organization (positive center). This is achieved by focusing on the moments of excellence, understanding which specific factors (leadership, relationships, technologies, business processes, structure, values, learning processes, external conditions, etc.) make the best organizational performance possible.
- b. **Desiring a dream** (what the organization can be): this phase amplifies the previous discovery and challenges the status quo by requiring visualization of a more valuable and vital future. Visualization of expected and potential results is especially important at this stage.
- c. **Design** (what the organization should be): this stage involves the creation of the organization's social architecture, based on provocative propositions that ground the dream in internal and external relational conditions that will make it possible.
- d. **Destination** (what the organization will be): the final phase integrates the resources and energy available to contribute to the realization of the organizational dream, as articulated in the provocative propositions generated in the previous phase. At this point in the process, everyone assumes specific responsibilities and concrete commitments, and it may even be necessary to redesign organizational processes and systems to ensure the realization of the dream.

## 4. Results

The study sample was determined considering the size of the population enrolled in fifth grade, the error tolerance and confidence level are shown in Table 1 obtaining a study sample of 37 students:

Table 1: Determining the study sample

N	Student population (5th year)	40	$n = \frac{Z^2 \sigma^2 N}{e^2 N - 1 + Z^2 \sigma^2}$ n = 37
p	Estimated proportion of positive indicator in program	0.75	
q		0.25	
e	Error tolerance	0.05	
Z	Normal deviation at 95% confidence	1.96	

At the beginning of the courses, students always show anxiety and concern because they do not have previous references about the course, since it is the first time it is developed. In view of this situation, we used the strategy of playful dynamics at the beginning and then integration dynamics to facilitate the subsequent conformation of the work teams to develop their course product. The results of the interview are shown in Table 2:

Table 2. Discovery phase I

<b>Discovering:</b> Describe a positive experience of innovation (designing new products, prototypes, proposing new ideas, etc.) since you started your studies,			
Nº	Units of meaning	Percent similarity	Category
37	The ideas were valid and innovative to develop and make a product.	38%	Recognized and valid new ideas that are developed and become a product.
	Ideas were accepted and recognized from the beginning in the creativity and industrial product courses.	41%	
	Good ideas came at the least expected moment and were spectacular.	13%	
<b>Theory:</b> According to the United Nations Industrial Development Organization, the qualitative aspect of creativity definitions are expressed through new ideas, being manifested the capacity of creative thinking in conducting and carrying out such ideas (ONUDI 2008)			

The need to propose innovative ideas to develop in the course was compensated not only with the dynamics to generate new ideas but also to give them openness and confidence to express their ideas. Paying attention to them, listening to them and taking care of their body language, definitely helped them to achieve their products. The results of the interview are shown in Table 3:

Table 3. Discovery phase II

<b>Discovering:</b> What do you value most from your innovation experience? Why?			
Nº	Units of meaning	Percent similarity	Category
37	The confidence provided by the teacher to present our ideas motivated us to move forward.	35%	Care and advice based on support and confidence for new ideas.
	The availability to assist and advise us improved communication in the courses.	19%	
	The teamwork allowed us to overcome any challenge set by the teacher.	5%	
<b>Theory:</b> Creative people fear being judged more than the failure of their ideas, and confidence allows them to be more willing to experiment and try to innovate. (Kelley and Kelley 2013)			

In education systems, the teaching role plays an important role in the assimilation of meaningful knowledge. Classroom presence is not enough to disseminate knowledge, since it is necessary to generate interaction for knowledge to flow in a logical and meaningful way. Teachers should guide and orient students to motivate them towards their own learning, and enhance group cohesion towards the achievement of a common project.

The support and guidance in real time (as far as possible), improves the communication process and the student-teacher interaction, facilitating their adaptation to new scenarios, as in the case of the creativity or industrial product course where they must generate new ideas that they themselves must develop.

The vast majority of students wish to have an innovation laboratory for the development of new products, followed by the desire for highly trained teachers, who through an area of innovation not only serve for the training of students, but also for interaction with the business environment and society.

The innovation area is an important element for an engineering program that seeks to modernize and respond to new business and market demands. In turn, an engineering area will allow the university to gain experience in technological surveillance and transfer processes. The results of the interview are shown in Table 4:

Table 4. Dream phase

<b>Dream:</b> Imagine you have a magic wand and it allows you to have three wishes around innovation come true. What are the three wishes to improve creativity and innovation in school to face the future?			
Nº	Units of meaning	Percent similarity	Category
37	Faculty specialized in innovation to support the development of new ideas and thesis.	43%	Program of industrial engineering support with laboratories, an innovation area and specialized teachers.
	To have an innovation laboratory for the development of new products.	81%	
	To have an innovation area to support us with advice and information.	27%	
<b>Theory:</b> Innovation and learning depend on a base infrastructure, such as standards, library, laboratory, investment, trained personnel, etc. that allows the transfer of knowledge to companies. And in order to innovate, it is not only enough to have the innovative capacity of individuals, but also to continuously improve what already exists (Velasco 2002)			

The future that students long for and envision is to be part of a school where the culture of innovation is rooted in its academic policy, of which they will be the direct beneficiaries by having better opportunities to generate companies or be part of them. Schools that promote creativity are promoting critical thinking of students, then it is necessary to evaluate what is being done and if it is the case, propose alternatives to build academic environments that respond to trends and demands (Trujillo 2012). The results of the interview are shown in Table 5:

Table 5. Design phase

<b>Design:</b> How do you imagine the school if we organized it to promote creativity and innovation? Express it through phrases, qualifiers, drawings, diagrams, etc.			
Nº	Units of meaning	Percent similarity	Category
37	A program recognized and successful for being the most innovative in the country.	59%	Future with innovative program and creative students
	A program with the most creative students in the country.	51%	
<b>Theory:</b> An industrial engineering program that promote creativity are promoting students' critical thinking, then it becomes necessary to evaluate what is being done and if so, propose alternatives to build academic environments that respond to trends and demands.			

The culture of any organization directly influences its management and its relationship with the work environment. On the one hand, we can count on very creative people who propose innovative solutions to different problems or needs, but these initiatives must take place within a management framework that facilitates and supports the processes. In this case, the organization under study has not defined specific innovation policies, let alone a frame of reference to support the viability of the new proposals.

From this we see the importance of evaluating the current corporate style of the organization from the perspective of the students, who were part of the appreciative interview because they are the main consumers of the service provided by the school and the reference before the society. A questionnaire was used to evaluate the school's corporate style, whose responses were grouped by similarity and yielded the following results (Table 6):

Table 6. Interview for corporative style

<b>Questionnaire Corporate style indicator</b>	
1. Are student or teacher projects promoted, giving them independence to move forward and participate in competitions?	Number of students ranked by similarity
Student projects are promoted, so that they can go ahead and win in the contest or call.	14
Students' projects are promoted, giving them permission to enter classrooms and inform that they are participating and having support.	12
The student demonstrates his ability to learn.	4
Greater emphasis should be placed on this.	14
Projects are promoted in shop windows or on social media, but more support is needed.	10
They promote projects but only collaborate with them when they achieve something	10
2. Are students or teacher recognized based on the contribution of ideas for improvement?	Number of students ranked by similarity
Recognition are made by the university, where the student is awarded a diploma that is delivered at a ceremony attended by the university authorities, the student's family, and the general public.	19
They must separate the recognition for academic performance from the contribution of new ideas	20
The contribution of ideas for improvement is not recognized.	24
3. Is there good informal communication between management or teachers and students?	Number of students ranked by similarity
There is good informal communication between managers, teachers, and students.	22
It exists but there are still teachers who do not communicate even formally.	14
Few teachers pay kind attention or offer suggestions outside of the classroom	11
There is between teachers and students, but not between the director and students.	16

## 5. Discussion and conclusions

According to the results, it can be observed that the role of the teacher is fundamental to promote creativity and innovation in the industrial engineering program, which does not necessarily involve having professors specialized in the subject of innovation, since students do not remain every day in a single course, but face an average of 4 to 6 courses with their own particularities (teacher, methodology, environment and evaluation system). In this case, and according to the results, the student finds in the support and confidence that the teacher can provide, the necessary complement to express their ideas or assimilate in a meaningful way the new knowledge provided.

Teamwork, good treatment and trust are immersed within the academic-administrative management of the program's direction, which must provide the necessary infrastructure so that the initiative, creativity, interest in continuous improvement, does not fade or is a particular characteristic of only some courses. The commitment and continuity of the efforts made and being made need a coherent macro environment to achieve an innovative program.



In turn, the good informal communication that exists between teachers and students is not enough to establish a corporate management style that allows me to achieve a good culture of innovation, the management of the industrial engineering program must assume a greater role in its commitment to continuous improvement. But informal communication can be used to promote or find a mechanism to recognize the improvement contributions made by students or teachers, in order to close the communication gaps between the program and students.

Although the appreciative process helps to motivate through positive thinking, influencing the values and emotions of the students, the process, which should have been continuous, had a period of silence. But it was taken up again in the following period, since the study group was once again responsible and the process could be resumed. At the beginning it was not easy to rescue only the positive attitude, because negative aspects were brought up, but with the support of two other colleagues it was possible to focus the interviews and dialogues on the positive factors.

The culture of innovation can be measured from different points of view, but the most appropriate dimension must be selected, according to the type of company and the level of innovative culture that the company has. In this case, it was considered to evaluate the corporate style with which the school is managed, from the students' point of view.

Appreciative inquiry promoted the innovation culture of industrial engineering students at a Peruvian university. Regardless of the policy of the program management, students participated in the course of the last two years in national competitions, where they won prizes. At the international level, they participated in the Mission Mars competition organized by NASA and were invited with their projects to live the experience. With another group of students, we worked on their research proposals with a view to publishing their results, and an average of eight scientific articles have been published to date in an indexed university journal, confirming the objective of this research.

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