

PERCEPTION OF THE INDUSTRY ABOUT STUDY PLANS AND TEACHING METHODOLOGIES OF THE ENGINEERING EDUCATION PROGRAMS AT UNIVERSIDAD POLITÉCNICA DE BAJA CALIFORNIA, MEXICO

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ABSTRACT

This study has, as objective, to describe the perception of the industrial area regarding the liaison actions of Universidad Politécnica de Baja California. We surveyed a non-probabilistic sample of 60 representatives from companies located in the city of Mexicali, Baja California; corresponding to six areas of industry: aerospace, automobile, communication, electronic, metallurgic, and plastics. The design of the study was quantitative, non-experimental, cross-sectional, descriptive; having as variables the analysis of liaison with the industrial area, the plans of study for the training of individuals to face and solve this challenges, and the teaching methodology for comprehensive training. In order to obtain the data, we designed a structured survey based on the surveys from Bedoya and Chávez (2010), UPP (2013), and Alcántar, Arcos, and Mungaray (2006). The survey was administered electronically, focusing on the data from Excel tables and were taken in 2017. The analysis technique was descriptive, and frequencies and percentages were obtained. The analysis results showed that the perception of the industrial area regarding the liaison actions from the university is, in general, good, specifically in the areas of Communication, Electronics, and Metallurgy.

KEYWORDS: Study Plans, Teaching Methodologies, Liaison with Industry, Technical Colleges

Article History

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INTRODUCTION

Higher education in Mexico has become, through time, a very complex government education system that implies the facing of a series of challenges among where coverage, quality, and pertinence stand out (Tuirán and Quintanilla, 2012). It has been an increasing preoccupation for the federal government, as shown in their most recent national development plans when promoting the liaison between universities and the production area as a vital function for national economy, seeking to strengthen teaching, research, technological, and innovational processes in higher education, in such a way that it provides a pertinent offer and quality to the requirements of the national industry (Chacón and Gil, 2013).

This comprehensive strategic process seeks to articulate the traditional functions of teaching, research, and cultural extension, incorporating the offer of services to the different areas of the socioeconomic environment, through a regulated methodology that produces a mutual benefit, which has been defined by many authors as liaison (Gould, 2002).

This liaison, circumscribed to the university-company-government environment, has produced, in an international environment, a boost to the economic development, transferring, to the productive area, the technological, scientific, and innovation contributions that universities produce, having, in some cases, government support (Eskowitz y Leydesdorff, 1995). Liaison is a means for interaction of the university with its environment, and favors knowledge updating, doing applied research, extending culture, increasing and improving of services that benefit the productive, social, and government areas, as well as the education system of a relation where everyone is benefited and which strengthens the institution and its position (Arcos, Alcántar y Mungaray, 2006).

When framing liaison from the National Development Plan (2013-2018) point of view, we find in the goal *Mexico with Quality Education* the express recognition, that in order to compensate for the Mexican education system deficiencies, an adequate liaison with the education, company, social, and research areas is required (DOF, 2013).

Inside the Mexican Higher Education System, we have the Technical Colleges Subsystem, to which the Universidad Politécnica de Baja California (UPBC) belongs, higher education institution located in the state of Baja California, and founded in May 10th, 2006, with its head office in the city of Mexicali, Baja California. UPBC purpose is to offer higher education focused on technological specialization, adopting the model based on competences, actively participating in the region development of the state through a higher liaison with the local industry, with a dynamic of offering pertinent academic programs that include in their curriculum the compulsory study of the English language (POEBC, 2006). Nowadays, UPBC depends of the General Management of Technical Universities and Colleges of the Ministry of Public Education (SEP).

The knowledge of the position of a university in its social, economic, and political environment, has become an increasing preoccupation for the actors that expect benefits from the resources and time used by higher education institutions (Alcántar and Arcos, 2004), for which UPBC establishes, as one of its main objectives, to have pertinent and efficient mechanisms in order to accomplish, through a liaison area, the establishment of continuous relations with the social, public, and private areas, as well as with the national and international higher education institutions, formalized through contracts, agreements, projects, and specific agreements. In addition, it is established that the conducting of liaison efforts will be aimed to consolidating the competencies acquired by the students doing internships, stays, and professional projects, essential for their training processes, and the labor promotion in the industrial environment. Through liaison, general actions of research and technological development are generated, that can contribute to the better performance of the region's companies, and allow the institution the reviewing and updating of its academic processes (POEBC, 2006).

Liaison has been considered, in UPBC, the main core in achieving a position with the industrial, government, and social areas, establishing 151 collaboration agreements in 2017, through which the university offers to collaborate in research projects, counseling, technological development programs, training courses, social support programs, and agreements to offer internships and stays for students; 77 of which are with the industrial area (UPBC, 2017). Liaison is considered, in the institution, as a dynamic activity that requires a continuous attention for the constant interaction demanded by different areas; the image, institutional position, and objective accomplishment of UPBC depend on such effort.

Through this statements, for UPBC, the following object of study was established, which allowed us to know the information for decision making and contributing to the improvement of liaison and management processes with the industrial environment of the region.

OBJECTIVES OF THE STUDY

The objective of the study is to describe the perception that the industrial area in Mexicali, Baja California, Mexico, has, regarding the liaison categories, the plans of study for the individuals training, and the teaching methodology for the comprehensive training of students in Universidad Politécnica de Baja California.

UNIVERSITY-COMPANY-GOVERNMENT LIAISON

It has been an increasing preoccupation for the federal government, as shown in their most recent national development plans when promoting the liaison between universities and the production area as a vital function for national economy, seeking to strengthen teaching, research, technological, and innovational processes in higher education, in such a way that it provides a pertinent offer and quality to the requirements of the national industry (Chacón and Gil, 2013). As stated by Gould (2002), this comprehensive strategic process seeks to articulate the traditional functions of teaching, research, and cultural extension, incorporating the offer of services to the different areas of the socioeconomic environment, through a regulated methodology that produces a mutual benefit, which has been defined by many authors as liaison.

This liaison, circumscribed to the university-company-government environment, has produced, in an international environment, a boost to the economic development, transferring, to the productive area, the technological, scientific, and innovative contributions that universities produce, having, in some cases, government support (Eskowitz y Leydesdorff, 1995). The incorporation of the research function in university activities in the XIX century constituted the 'first revolution', which detonated into the current role of assuming new responsibilities with societies through liaison (Etkowitz, Webster y Healy, 1998). Liaison is a means for interaction of the university with its environment, and favors knowledge updating, doing applied research, extending culture, increasing and improving of services that benefit the productive, social, and government areas, as well as the education system of a relation where everyone is benefited and which strengthens the institution and its position (Arcos, Alcántar y Mungaray, 2006).

In Mexico, when framing liaison from the National Development Plan (2013-2018) point of view, we find in the goal *Mexico with Quality Education* the express recognition, that in order to compensate for the Mexican education system deficiencies, an adequate liaison with the education, company, social, and research areas is required. Thus, the National Development Plan 2013-2018 manages two approaches related to liaison; the first one proposes to boost a higher liaison that allows to offer pertinent academic programs, according to the region social and economic needs in order to favor the inclusion of young people in the national development, and the second approach seeks to make the scientific, technological, and innovation development the main core of the sustainable progress through liaison between universities, research centers, and the economic area (DOF, 2013).

For the National Association of Universities and Higher Education Institutions (ANUIES, 2017), liaison must be considered, in higher education institutions, as an strategic activity that will significantly complete the training of their graduates, which can influence the social wellbeing and economic growth, through the transference of knowledge and the promotion of cultural, sports, and social activities.

The scientific, technologic, and innovation development in Mexico requires the making of research projects through liaison: education institution and productive system, with the purpose of transferring science, technologic, and innovation knowledge to the different social education, government, and business areas. Regarding this, the National Committee of

Science and Technology (CONACYT), as a public and decentralized organization, has as function to collaborate with the federal government in order to promote science, technology, and innovation politics with scholarships programs in support of the training for human, scientific, and technologic resources, supporting researchers from the National Researchers System (SNI) to promote the scientific research development and academic strengthening, as well as providing economic resources aimed for public and private higher education institutions, research centers, laboratories, and companies in the National Registry of Scientific and Technologic Institutions and Companies (RENIECYT). Through these programs, CONACYT facilitates liaison processes that higher education institutions promote with the productive and social areas (CONACYT, 2017).

UNIVERSITY LIAISON IN MEXICO

Nowadays, for universities in Mexico, liaison has been a main element in the restructuring of education, research, and extension processes. The historical records, at an international level, of the different approaches or models for socioeconomic environment liaison, have served as the example to the model made by education authorities in different strategies in the government six-year plans (DOF, 2013).

Liaison, as university function and a technology and innovation development factor, has been increasingly recognized by governments and the economic area of the world's industrialized countries, and its increasing participation in this function has been objecting of studies and evaluation during the last decades, with the purpose of orienting public politics and the assignation of resources based on an informative platform regarding the technical overview of the company-university-government liaison effect and its effectiveness in different socio-geographic and socio-politic environments. Universities have participated more actively in the social development when incorporating, in their teaching activities, research and extension, transforming in specialized universities, according to their regional context, going from extension to liaison, and from research to innovation (OCTS-OEI/RICYT, 2017).

We can consider that liaison processes between universities and the increasing industrial area began at the end of the XVIII century, where the need to take classic knowledge (mode 1) arose, applying it to problem-solving (mode 2); this new way of producing knowledge, when interacting with different elements, acquires, with time, an increasing social responsibility; is in this way that knowledge is created in diverse organizations and institutions, producing a bigger conscience regarding science and technology advancements and how they can have an impact on social, political, and economic interests. Regarding the structure of research and development programs (D+I) for the creation of links between the industrial and academic areas, as much in the United States as in the European Union, there have been permanent efforts to intensify this liaison between universities and industries (Gibbons, *et al.*, 1997).

Thus, the National Development Plan 2013-2018 manages two approaches related to liaison; the first one proposes to boost a higher liaison that allows to offer pertinent academic programs, according to the region social and economic needs in order to favor the inclusion of young people in the national development, and the second approach seeks to make the scientific, technological, and innovation development the main core of the sustainable progress through liaison between universities, research centers, and the economic area. In order to do this, among its strategies, it proposes to contribute to the transference and use of knowledge, linking higher education institutions with the public, social, and private areas (DOF, 2013). This coincides with the established approach in the competence management model of Technical Colleges, where it establishes that IDT projects will be aimed to achieve increasing improvements in industrial processes and economic activities of the state in the influence environment of the university (SEP-CUP, 2009).

In this sense, the surging of the Technical Colleges subsystem set out by the Mexican Education System in 2002 seeks to resize the Engineering careers through an education model that includes variables such as quality, pertinence, liaison, and flexibility in their academic programs without neglecting the incorporation of values and attitudes of the being in the curriculum, preparing professionals in order to face the challenges presented by globalization, which makes the industry demand competent and productive personnel in order to successfully compete with the global market (Garza, 2003).

Education authorities, aware of the challenge to propose a training plan for engineers different to the traditional method and according to our country's reality, have been concerned about analyzing and redefining the model of the Technical Colleges Subsystem, for which the Technical Colleges Coordination (CUP) established in 2004 the *Guide for the Creation and Operation of Technical Colleges* (SEP-CUP, 2005), and, in 2009, it published the *Management Model by Competencies of Technical Colleges* (SEP-CUP, 2009). These documents require the reach and methodology that will be used to form the creation of new Technical colleges, as well as the integration of the curricula in study plans, and the academic and administrative management.

In the state of Baja California, Universidad Politécnica de Baja California (UPBC (POEBC, 2006) was created; public organization, decentralized from the state government, with its own legal personality and patrimony, subject to the different federal and state laws, suitable for a public entity that manages federal and state resources for its operation and growth; it establishes, as one of its main objectives, to have pertinent and efficient mechanisms in order to accomplish, through a liaison area, the establishment of continuous relations with the social, public, and private areas, as well as with the national and international higher education institutions, formalized through contracts, agreements, projects, and specific agreements. In addition, it is established that the conducting of liaison efforts will be aimed to consolidating the competencies acquired by the students doing internships, stays, and professional projects, essential for their training processes, and the labor promotion in the industrial environment. UPBC's permanent challenge is to train professionals that share the classroom theory with practice through internships and stays in the industry that allow them to acquire the competences needed to participate in the region and state development; the professional training must be paired with social commitment and the promotion of values that society requires to promote an environment of economic well-being and social peace. Through the liaison, general actions of research and technological development are generated, that can contribute to the better performance of the region's companies, and allow the institution the reviewing and updating of its academic processes

METHODS

The study method is quantitative, non-experimental, cross-sectional, and descriptive (Hernández, Fernández, and Baptista, 2014). The variables analyzed are: liaison with the industrial area, study plans for the training of individuals in order to face and solve challenges, and the teaching method for comprehensive training. The population analyzed was representatives of the industry (local, regional, national, and international) located in the city of Mexicali, Baja California. We used a non-probabilistic sample of 60 companies: small (from 1 to 25 employees), medium (from 26 to 100 employees), and large (more than 101 employees). We considered six areas of the industry: Aerospace, Automobile, Communication, Electronics, Metallurgy, and Plastics. The gender of the representatives from companies that participated was indistinct: we considered both women and men. The age of all participants ranged from 18 to 57 years old.

In order to collect the perception from the subjects of analysis was a structured survey based on the *Employer's Survey of the Management of Liaison and Extension, and Monitoring of Graduates from Universidad Politécnica de Puebla* (UPP, 2013), the *Employer's Survey of the Industrial Engineering program* from the Observatory of the Graduate's Monitoring and Liaison of Universidad Tecnológica de Pereira (Bedoya and Chávez, 2010), and the Study survey of *Liaison and Positioning of Universidad Autónoma de Baja California with its social and productive environment* of Alcántar, Arcos, and Munguray (2006). The survey was administered electronically and the data was captured and organized in Excel tables for its analysis. The analysis technique was descriptive, and the data corresponds to the year 2017.

RESULTS

The results of the application of the surveys are described and organized in three topics: liaison with the industrial area, study plans for the training of individuals, and the teaching method for comprehensive training. The results correspond to 60 surveys applied to companies' representatives for the Aerospace, Automobile, Communication, Electronic, Metallurgic, and Plastics areas located in the city of Mexicali, the capital of the state of Baja California, Mexico. The data correspond to the year 2017 and was organized in tables, providing frequencies and percentages.

We surveyed 60 representatives from companies of the areas: Aerospace (20%), Automobile (13.3%), Communication (15%), Electronics (21.7%), Metallurgy (20%), and Plastics (10%). We surveyed large (58.3%), medium (20%), and small (21.7%) companies. The surveyed participants were 56.7% feminine gender and 43.3% of the masculine gender. The ages of surveyed participants ranged from 18 to 57, with the highest percentage found in the range of 26 to 33 years (31.7%). 61.7% of surveyed people had a Bachelor's degree, 16.7% had a Master, and 13.3% had a specialty.

Liaison of Universidad Politécnica de Baja California with the Industrial Area

The results of the surveys showed that the area that considers Universidad Politécnica de Baja California's liaison on a high relevance level, 55.4%, is Communication (40% answered it is very important and 15.4% answered it is important), followed by the electronic area, which considers it of high importance with 56.2% (10% as very important and 46.4% as important); 30% of surveyed people thought that it is very important for the Metallurgy area. 57.1% thinks that liaison of the institution with the Metallurgy area is less important; in the Aerospace area, 50% thought it is more or less important; the Automobile area had a high percentage of the answers less important and of little importance, with 14.3% and 36.4% respectively (a total of 50.7%) (See table 1).

Table 1: Perception about Liaison of Universidad Politécnica de Baja California from the industrial area in Mexicali, Baja California, Mexico in 2017

Perception of the Industrial Area														
Area	1. Very Important		2. Important		3. More or Less Important		4. Less Important		5. Less Important		I don't know		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Aerospace	1	10	3	23.1	4	50	1	14.3	2	18.2	1	9.1	12	20
Automobile	0	0	1	7.7	1	12.5	1	14.3	4	36.4	1	9.1	8	13.3
Communication	4	40	2	15.4	0	0	0	0	1	9.1	2	18.2	9	15
Electronics	1	10	6	46.2	2	25	1	14.3	2	18.2	1	9.1	13	21.7
Metallurgy	3	30	0	0	0	0	4	57.1	0	0	5	45.5	12	20
Plastics	1	10	1	7.7	1	12.5	0	0	2	18.2	1	9.1	6	10
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10	100	13	100	8	100	7	100	11	100	11	100	60	100

Study plans of Universidad Politécnica de Baja California for the training of individuals

Regarding the study plans offered by Universidad Politécnica de Baja California for the training of individuals in order to face and solve challenges, the representatives of the automobile area had a good perception (62.5%); followed by the Electronic industry (30.8%), Metallurgy (25%), Plastics and Aerospace (16.7% each). The opinions were, on the most part, for the ‘very good’ answer, 66.7% of the Communications area answered they have a very good perception about the study plans of the Educational Institution mentioned; the Plastics and Aerospace industries answered they have a very good perception (50% each). Only the Communications (11.1%), Aerospace (8.3%), and Electronic (7.7%) areas answered the study plans are excellent. The high percentage of *I don't know* the answers (26.7% total) is interesting, especially in the Metallurgy area (50%), which invites to infer about dealing with the liaison of the Institution with this industry area (see table 2).

Table 2: Perception of the Industrial area in Mexicali, Baja California, Mexico, about the Study Plans of Universidad Politécnica de Baja California for the training of Individuals in order to Face and Solve Challenges. Year 2017

Industrial Area	Perception of the Industrial Area											
	Good		Excellent		Very good		I don't Know		Regular		Total	
	n	%	n	%	n	%	N	%	n	%	n	%
Aerospace	2	16.7	1	8.3	6	50.0	3	25.0	0	0	12	100
Automobile	5	62.5	0	0.0	0	0.0	3	37.5	0	0	8	100
Communication	1	11.1	1	11.1	6	66.7	0	0.0	1	11.1%	9	100
Electronics	4	30.8	1	7.7	5	38.5	3	23.1	0	0.0	13	100
Metallurgy	3	25.0	0	0.0	2	16.7	6	50.0	1	8.3	12	100
Plastics	1	16.7	0	0.0	3	50.0	1	16.7	1	16.7	6	100
Other	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
Total	16	26.7	3	5.0	22	36.7	16	26.7	3	5.0	60	100

Teaching method of Universidad Politécnica de Baja California for comprehensive training

The opinions of the surveyed representatives in the industrial area regarding the teaching method of Universidad Politécnica de Baja California for the comprehensive training of its students, most of the answers were very good (33.3% of the total), 46.2% of the answers were from the Electronic area, 44.4% from Communication, 33.3% from Aerospace, 16.7% from Metallurgy, and 12.5% from the Automobile area. A total of 25% had a good perception; this was the answer of the Automobile area with 50%, Aerospace with 25%, Electronic with 23.1%, and Communication with

22.2%. Even though the opinions are favorable, we must observe that only 6.7% of the total answered that the teaching method is excellent, except from 22.2% of the Communication industry. It is also important to notice that 30% of the total answered they do not know (see table 3).

Table 3: Perception of the Industrial Area in Mexicali, Baja California, Mexico Regarding the Teaching Method of Universidad Politécnica de Baja California for the Comprehensive Training of its Students, by area. Year 2017

Area	Perception of the Industrial Area											
	Good		Excellent		Very Good		I don't know		Regular		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Aerospace	3	25	1	8.3	4	33.3	4	33.3	0	0	12	100
Automobile	4	50	0	0	1	12.5	3	37.5	0	0	8	100
Communication	2	22.2	2	22.2	4	44.4	0	0	1	11.1	9	100
Electronics	3	23.1	1	7.7	6	46.2	3	23.1	0	0	13	100
Metallurgy	2	16.7	0	0	2	16.7	7	58.3	1	8.3	12	100
Plastics	1	16.7	0	0	3	50	1	16.7	1	16.7	6	100
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	25	4	6.7	20	33.3	18	30	3	5	60	100

CONCLUSIONS

The results of the analysis show that the perception had about the liaison actions of Politécnica de Baja California by the industrial area in Mexicali, Baja California, in general, is very good.

The Communication industry is the one that has the most favorable perception of the liaison activities of Universidad Politécnica de Baja California with a high relevance level (55.4% of the total 40% that answered very important and 15.4% that answered it is important); followed by the Electronic industry that thinks it is important (56.2% of the total 46.2% that answered it is important and 10% answered it is very important); and the Metallurgy industry, with 30% who thinks it is very important regarding the study plans offered by the education Institute for the training of individuals in order to face and solve challenges; the Automobile area is the one that showed the best perception (62.5% answered good); followed by the Electronic industry (30.8% good), and the Communication industry has a very good perception (66.7%) about it.

The perceptions regarding the teaching method offered in the education Institution for the comprehensive training of its students, for the most, were very good (33.3% total), especially the perception of the Electronic (46.2%) and Communication (44.4%) industry. It is important to observe that there was low perception regarding the excellence in liaison activities, study plans for the training of individuals in order to face and solve challenges, and the teaching method for comprehensive training. In addition, it is relevant to observe that 30% of the total answered they do not know about the study plans offered (26.7% answered *I don't know*) and the teaching method for comprehensive training (30% answered *I don't know*).

It is recommended that Universidad Politécnica de Baja California promotes liaison with the industry in Baja California; and re-positions it with the productive, social, and public areas. Furthermore, it is recommended to make positioning, liaison, and image studies of the university with the participation of the productive, social, and public areas.

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