The Degree of Assimilation of Generic Competencies by Future Engineering Graduates of Tlaxcala

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Abstract: Higher education in the world is a field of profound transformations, with repercussions at the economic, social, political and cultural levels. For UNESCO "*Education gives people autonomy by providing them with the knowledge and skills necessary for their own improvement through comprehensive training*." In order to know the degree of skills acquired in their training by future graduates of the engineering related careers of schools of Higher Education of the State of Tlaxcala, a diagnosis was made to four government institutions, from which it is expected to know the trends that have the objects of study. This type of study was descriptive and deterministic.

1. Introduction:

"Never before in history has the well-being of nations been so closely linked to the quality and scope of their higher education systems and institutions." (World Conference on Higher Education, June 2003).

Convinced that education is one of the fundamental pillars of human rights, democracy, sustainable development, and peace, so it must be accessible to all throughout life, and that measures are needed to ensure coordination and cooperation between the various sectors and within each of them and, in particular, between general education, technical and professional secondary and postsecondary, as well as between universities, colleges, and technical institutions.

In a rapidly changing world, there is a need for a new vision and a new model of higher education, which should be centered on the student, which requires, in most of the countries, reforms in depth and a policy of expanding access, to accommodate increasingly diverse categories of people, as well as a renewal of the contents, methods, practices and means of transmitting knowledge, which must be based on new types of links and collaboration with the community and with the broadest sectors of society. (UNESCO, 2011).

Higher education institutions must train human resources to become citizens in relation to the graduation profile, provided with a critical sense and capable of analyzing the problems of society, as well as finding their solutions.

The scope of the article is to show the comparison of assimilation of academic competences by future graduates through study groups of the same career; of public institutions that offer educational programs of engineering profile of the State of Tlaxcala, and that the condition of being studied, was that they offer to each other, engineering with the same name.

2. Methodology:

The methodology used allows obtaining direct information from students who are in the phase of professional practices, the applied instrument is the one developed by the Center for Research for Development, A.C. (CIDAC) in its 2014 research. The results are compared between graduation profiles of the objects of study in order to know and/or see the degree of assimilation of the evaluated competences. This research focuses on, collect, analyze the information and conclude based on the results; the above is based on identifying the similar generic competencies that exist in educational systems of the National Technological Institute of Mexico and the system of Technological and Polytechnic Universities, of these, taking the Technological Institute of Apizaco, the Higher Technological Institute of Tlaxco, the Polytechnic University of Tlaxcala and the Polytechnic University of Tlaxcala, Poniente Region.

We worked in six different stages (Montaño, 2014 and Gonzalez, 2009), which are described below:

2.1. First stage: Identification of competencies and choice of instrument:

This phase focused on a bibliographic review to identify the research related to the problem and determine the main generic competencies that future engineering graduates of higher level institutions should have; the result of the research carried out by the CIDAC was taken as a basis, which allowed the selection of five generic competencies and placing them in a questionnaire. In relation to the profiles that are offered in two institutions, once analyzed, the results are:

- Industrial engineer
- Mechatronics engineering
- Electromechanical engineering
- Bussines management engineering
- Logistics engineering

2.2. Second stage: Resulting survey:

A survey consisting of five items was generated; and the mechanism to evaluate it is by means of the Likert scale (Likert, 1932). Each question has five possible answers, in such a way that the student who underlined five skills of the competition, I had her; and the one who only underlined the only one did not have the competence. See table 1.

Table 1. *Generic competencies and skills.*

application of the pilot survey, in which 37 surveys were collected. The calculation of Cronbach's Alpha formula was used for the variances:

$$\alpha = \left[\frac{k}{k-1} \right] \left[1 - \frac{\sum_{i=1}^{k} S_i^2}{S_t^2} \right]$$

Where:

(K/K-1) =	1.25
Σ Individual Variances =	9.518018
Σ Total variances =	33.304805
Σ Individual Variances / Σ Total variances =	0.2857851
1 - (Σ Individual Variances / Σ Total variances) =	0.7142149
Cronbach's Alpha =	0.8928

2.4. Fourth stage: Application of the questionnaire:

According to data from the Ministry of Economy of 2012, the main areas of work of the automotive sector are Virtual Design, Project Management, and Technical Areas.

Ítems				
Mathematics	**Leadership**	**Team Work**	**Communication**	**Innovation / Entrepreneurship**
Knowledge and basic management of differential equations.

Knowledge and basic managementof mathematical theorems.

Knowledge and basic managementof trigonometry

Knowledge and basic management of algebra.

Knowledge and basic calculation management. | Decision making in an accurate and agile manner autocratically

Decision making in an accurate and agile manner in a democratic manner.

Sense of responsibility.

Initiative or proactivity.

Ability to motivate others. | Distribution of tasks in the work team.

Negotiation and conflict resolution within the team.

Preposition of the objectives of the team versus personal ones.

Know how to listen to others

Team work coordination. | Written communication (in Spanish).

Oral communication (in Spanish).

Communication in English: written.

Communication in English: oral.

Ability To synthesize information. | Detection of improvement opportunities in processes or product.

Detection of new business opportunities.

Implementation of new projects.

Generation of new ideas.

Development of strategic alliances. |

Source: Own elaboration, 2017.

2.3. Third stage: Pilot survey and reliability:

A pilot test was generated that contains 5 items and was applied to a total of 37 students from the Technological Institute of Apizaco. For the reliability measurement of the questionnaire, the Cronbach's Alpha index was used (Cronbach, 1951). The calculation was made with the

The professional profiles to which the study is focused, are those that exist in two or more institutions and those occupied by the automotive sector, are shown in table 2, it also presents the sample size that was considered for the study.

Table 2. *Professional profiles, study objects and sample size.*

Apizaco Technological Institute	Sample Size
Industrial engineer	25
Mechatronics engineering	24
Electromechanical engineering	22
Bussines management engineering	12
College Politécnica of Tlaxcala	
Industrial engineer	25
Mechatronics engineering	26
College Politécnica Of Tlaxcala Region Poniente	
Logistics engineering	25
Tlaxco Superior Technological Institute	
Electromechanical engineering	21
Bussines management engineering	15
Logistics engineering	23

Taking the above information, the institutions that offer careers in the state of Tlaxcala, are the following:

- Apizaco Technological Institute (ITA)
- Tlaxco Superior Technological Institute (ITST)
- College Politécnica of Tlaxcala (UPTx)
- College Politécnica of Tlaxcala Region Poniente (UPTrep)

This part consisted of contacting the executives of the state institutions where the questionnaire would be applied and requesting their authorization for it. The sampling was deterministic and simple random, because the population is determined by the group to which they are enrolled, we sought to maintain a balance between the number of students who are in the same career, and the semester in which the student was enrolled, which should be between the eighth and ninth semesters, as applicable.

2.5. Fifth stage: Capture information:
In this phase, information was captured and analyzed in the Minitab software. For the measurement of the internal consistency index or reliability of the questionnaire, the Cronbach alpha index was used (Cronbach, 1951).

2.6. Sixth stage: Descriptive analysis of information:
In this phase the descriptive analysis of the information was carried out, based on genders, ages (IT Apizaco, ITST and the Polytechnic University of Tlaxcala from 21 to 23 years old, and the Polytechnic University of Tlaxcala Region Poniente from 21 to 27 years old) and the generation of income (IT Apizaco 2013 and the remaining 2014).

3.Results and Discussion:
Analysis by competition among future graduates of higher level institutions
In order to perform the analysis, hypothesis testing is a well-organized step-by-step procedure that is applied to make a decision. For the hypothesis test, two different formats are usually used. The P value approach, which is a hypothesis testing process that has gained popularity in recent years (Jhonson - Kuby 2004).

4. Conclusions:
- *Industrial engineer*
For the case of this career, derived from the approach:
$$H_0: \mu\ tec\ apizaco = \mu\ pol.tlaxcala$$
$$H_a: \mu\ tec\ apizaco \neq \mu\ pol.tlaxcala$$

Observing the results of the P value, **H₀ is accepted**, that is, there is no difference in the assimilation of the five competencies of the future graduates of the study universities.

It can be mentioned that for a parent; From an economic point of view, it is convenient to send your child to the Polytechnic University of Tlaxcala to receive their professional training, since the educational model of the Polytechnic Universities is concluded in three and a half years, unlike National Technological Mexico, in this, the professional preparation is concluded in four and a half years.

- *Mechatronics engineering*
For the case of this career, derived from the approach:
$$H_0: \mu\ tec\ apizaco = \mu\ pol.tlaxcala$$
$$H_a: \mu\ tec\ apizaco \neq \mu\ pol.tlaxcala$$

Observing the results of the P value, **H₀ is rejected**, that is, there is a difference in assimilation in four of the five competencies of the future graduates of the study universities.

- *Electromechanical engineering*
For the case of this career, derived from the approach:
$$H_0: \mu\ tec\ apizaco = \mu\ tec.tlaxco$$
$$H_a: \mu\ tec\ apizaco \neq \mu\ tec.tlaxco$$

Observing the results of the P value, **H₀ is accepted**, for three of the five competencies (leadership, communication and innovation/entrepreneurship) for the mathematics and teamwork competencies, H₀ is rejected, that is, there is a difference in the assimilation of the competencies.

Table 3. *Comparison of assimilation of generic competences ("P" value) of future graduates by institution.*

Generic Competences					
Professional profile / Study institutions	Mathematics	Leadership	Team work	Communication	Innovation / Entrepreneurship
Industrial engineer					
Tec. Apizaco - College Politécnica of Tlaxcala	P = 0.907	P = 0.430	P = 0.533	P = 0.426	P = 0.526
Mechatronics engineering					
Tec. Apizaco - College Politécnica of Tlaxcala	P = 0.000	P = 0.003	P = 0.000	P = 0.000	P = 0.068
Electromechanical engineering					
Tec. Apizaco - Tec. Tlaxco	P = 0.000	P = 0.192	P = 0.009	P = 0.194	P = 0.780
Business management's engineering					
Tec. Apizaco - Tec. Tlaxco	P = 0.000	P = 0.003	P = 0.000	P = 0.000	P = 0.068
Logistics engineering					
Tec. Tlaxco - College Politécnica of Tlaxcala Region Ponente	P = 0.023	P = 0.982	P = 0.618	P = 0.534	P = 0.005

Source: Own elaboration, 2017.

- *Bussines management engineering*

For the case of this career, derived from the approach:

$$H_0: \mu \, tec \, apizaco = \mu \, tec.tlaxco$$
$$H_a: \mu \, tec \, apizaco \neq \mu \, tec.tlaxco$$

Observing the results of the P value, **H_0 is rejected**, that is, there is a difference in assimilation in four of the five competencies of the future graduates of the study universities.

- *Logistics engineering*

For the case of this career, derived from the approach:

$$H_0: \mu \, tec \, tlaxco = \mu \, politécnica \, poniente$$
$$H_a: \mu \, tec \, tlaxco \neq \mu \, politécnica \, poniente$$

Observing the results of the P value, **H_0 is accepted**, for three of the five competencies (leadership, communication, and teamwork) for the mathematics and innovation/entrepreneurship competencies, **H_0 is rejected**, there is a difference in the assimilation of the competencies for future graduates.

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