# Relevance of a Teaching Program to the Challenges of Industry 4.0

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*Objective: to identify the degree of relevance of the Food Science and Technology Engineering Teaching Program (PDICTA) to face the challenges demanded by the Fourth Industrial Revolution or Industry 4.0. Method: to collect the data, a survey was applied as a measurement instrument, using the Likert scale of five response options to 10 items for a representative sample of 12 teachers and 14 graduates of the program. For the analysis of the survey data, descriptive statistics was applied. Results: The findings were as follows: in 4 of the items, the professors and graduates declared to agree, while in the remaining 6 items, the results showed different responses that were at levels that varied from disagreeing, neutral and agreement. Discussion and conclusion: that both professors and graduates agreed that the former supported the latter in the development of four of the ten skills or competencies demanded by Industry 4.0, indicating that the PDICTA is in a process of exchange to enter the labor market demanded by Industry 4.0.*

*Keywords: education 4.0, industry 4.0, fourth industrial revolution*

## INTRODUCTION

The Industry 4.0 platform (I.4.0) is a concept promoted mainly by the Cluster Institute in the World Economic Forum Report (2016), and by related actors such as Klaus Schwab and the Industry 4.0 Working Group (group formed by representatives of the German company Bosch and the German Academy of Sciences and Engineering), so most of those who write and promote this idea come mainly from Germany or are related to the mentioned international economic proposal.

Although this platform is used as a synonym for highly computerized and automated manufacturing, the term actually encompasses a broader definition. The related literature is relatively recent, so there is no agreed definition by all the major institutions and actors. Hermann and Otto (2015) conducted a literature review on the subject and proposed a multi-authored definition summarized by six key words: interoperability, virtualization, decentralization, real-time capacity, service orientation, and modularity.

In this sense, Schwab (2016) provides an example that helps to understand how industrial revolutions changed over time. During the first Industrial Revolution (IR), water and steam were used to mechanize production. During the second IR, electric power was used to create mass production. During the third IR, electronics and information technologies were used to automate production. The fourth IR is beyond an improvement on the third IR, in which the advance of new technologies blurs or fades the lines between the physical, digital and biological worlds. New technologies evolve at an exponential rate and there is no historical precedent to mark the beginning of evolution, hence they are called disruptive technologies, i.e. something that radically changes the way things are done (Christensen, 1997). These advances are led by the emergence of artificial intelligence, robotics, the Internet of Things, autonomous vehicles, bio and nanotechnology, three-dimensional (3D) printing, materials science, energy storage (Diwan, 2017) and quantum computing (Moret, 2013).

According to the League of European Research Universities, LERU (2016), this revolution, also known as the knowledge economy, is related to information, communications, education and technological innovation; and the development of research, robotics, and nanotechnology among other disciplines, so that, since the end of the 20th century, investment in "intangible capital" (knowledge, skills, attitudes) has grown considerably even more than tangible capital (machinery, raw materials), etc.

Because of this, in the U.S., the Partnership for 21st Century Learning [P21] (n.d.) has developed a popular vision for student success in the new global economy and has identified the skills, knowledge, and experience that must be mastered to succeed in work and life in the world in the 21st century. These main elements are described below:

1. Preparation in key themes and 21st century issues: examples of key themes would include: English, Mathematics, Science and the Arts.
2. Examples of 21st century issues would be: Global Awareness, Practical Civic Knowledge and Practical Health Knowledge.
3. Learning and innovation skills: creativity and innovation; critical thinking and problem solving; and communication and collaboration.
4. Information: skills in the use of digital media and technology; information literacy; practical media knowledge; and practical knowledge in ICT (Information, Communications and Technology).
5. Life and career skills: flexibility and adaptability; initiative and self-direction; and, social and intercultural skills; and, productivity and responsibility.

**Objective of the Research**

The purpose of this paper is to identify the degree of relevance of the Program of Engineering in Food Science and Technology (Programa de Ingeniero en Ciencia y Tecnología de Alimentos (PICTA) in Spanish).

For Fisk (2017), the relevance of any educational program in the Fourth Industrial Revolution or Industry 4.0, promotes that students learn not only the necessary skills and knowledge, but also to identify the source to learn these skills and knowledge. In other words, learning is based on them in terms of where and how to learn, and tracking their performance is done through data-based customization. Peers become very important in their learning. They learn together from each other, while teachers assume the role of facilitators in their learning.

**Literature Review**

In a research on this topic Hussin, (2018) reports the ten skills that graduates should have when facing the challenges presented by the Fourth Industrial Revolution, also known as Industry 4.0, being these:

Complex Problem Solving, Critical Thinking, Creativity, Personnel Management, Coordination with Others, Emotional Intelligence, Judgment and Decision Making, Service Orientation, Negotiation and Cognitive Flexibility, which will be explained below.

**Complex Problem Solving**

Wüstenberg (2011), points out that complex problem solving (CPS) is the successful interaction with task environments that are dynamic (i.e., change depending on user intervention and/or time) and in which some, if not all, regularities of the environment can only be revealed by the successful exploration and integration of the information obtained in that process.

The main differences between reasoning tasks and CPS, are that in the latter case (1) not all the information needed to solve the problem is given from the beginning, (2) the problem solver needs to actively generate information through the application of appropriate strategies, and (3) procedural skills have to be used to control a given system, such as when feedback is used to persist or change behavior or to counteract unwanted developments initiated by the system (Funke, 2001).

In summary, at the conceptual level, reasoning and CPS assess the cognitive skills needed to generate and apply rules, which should generate correlations between both constructs. However, depending on the different characteristics of the task and the cognitive processes described above, SCP should also show divergent validity to reasoning.

On the other hand, Lohman and Michael (2000), in their research, mention that problem solving is an important aspect of professional practice. Professionals must be able to "give new meaning to uncertain, unique or conflicting situations" that they regularly face in their work (Schön, 1987, p. 39). These types of situations, commonly known as poorly structured problems, lack a clear identification of the problem, procedures to identify solutions and criteria to evaluate solutions (Frederiksen, 1984). Increasingly, academic programs are recognizing the need for professionals to be able to solve poorly structured problems and are incorporating instructional experiences into their curricula to help students develop problem-solving skills (Mandin, Jones, Woloschuk, & Harasym, 1997).

**Creativity**

In recent research, Puncreobutr (2016), mentions that changes in the social economy have been constantly evolving. Formally, it was the era of Economy 1.0, until it became the digital social economy, the era of Economy 4.0, which has played an important role in changing lifestyles.

The author emphasizes that "innovative skills for living in the age of Education 4.0, in addition to possessing 21st century skills consisting of leadership, collaboration, creativity, digital literacy, effective communication, emotional intelligence, entrepreneurship, global citizenship, problem solving and teamwork; must also include the skills to build an intelligent nation or intelligent people with critical thinking, creativity and innovation, intercultural understanding, information and media literacy, professional and learning skills" (Puncreobutr, 2016, p. 94).

Education 4.0 meets the needs of society in an "innovative era" (Puncreobutr, 2016, p.3). It is in accordance with the changing behavior with the special characteristics of parallelism, connectivism and visualization (Goldie, 2016). This learning management should help to develop in the student, the capacity to apply the new technology, which will help them to develop to the demands of the changes in the society.

Likewise, Terkowsky and Haertrel (2013) in their essay Fostering the Creative Attitude with Remote Lab Learning Environments, mention that creativity has been proclaimed as one of the most important skills of the 21st century.

This slightly provocative essay induces possible boundary conditions and restrictions to encourage creativity in engineering education. Furthermore, it presents the first results of a small preliminary study on higher engineering education curricula, carried out in the German project "ELLI - Teaching and Learning in Engineering Education", suggesting a lack of creative education in the curricula examined. In addition, it presents the results of a descriptive analysis of the didactic approach of the completed EU project "Pe-TEX - Platform for e-Learning and Telemetric Experimentation" which provides information on the possibilities of fostering creative attitudes in engineering education through remote laboratories.

**Cognitive Flexibility**

Cognitive flexibility is defined as adjustment to specific situations, the ability to move from one idea to another, or the ability to consider various problems in terms of multiple dimensions (Stevens, 2009), meaning that the individual is aware of his options, can adapt to new situations, and feels competent for them (Bilgin, 2009).

From this definition, Bülent (2013) developed a research in which the contributions of attachment, irrational beliefs and psychological symptoms to the prediction of cognitive flexibility were analyzed. A sample of 436 students studying in different departments and faculties at the University of Mersin was taken. The Cognitive Flexibility Scale, the Relationship Scale, the Irrational Belief Scale and the Short Symptom Inventory were applied. Multiple regression analysis and stepwise regression analysis were used to analyze the data.

Research results showed that all independent variables explained approximately 41% of cognitive flexibility; according to stepwise regression analysis, it was found that students' cognitive flexibility was better predicted by the variables of irrational beliefs, obsessive attachment, and anxiety (Bülent, 2013).

Similarly, Esen-Aygun (2018) carried out a research work whose purpose was to investigate the cognitive flexibility of trainee teachers in terms of specific variables and to determine the relationship between the cognitive flexibility of trainee teachers and interpersonal problem-solving skills. The study was designed using the descriptive correlation model. Data were collected through the Cognitive Flexibility Inventory and Interpersonal Problem Solving Inventory from 531 teachers studying in the Primary Training Departments during the fall semester of the 2017-2018 academic years.

The findings indicated that there were significant differences according to gender and maternal education level, while there were no significant differences according to socioeconomic class level, academic department and parental education level, or socioeconomic and socio cultural status. In addition, the results showed that there was a relationship between teachers' cognitive flexibility and interpersonal problem-solving skills.

**Critical Thinking**

According to the American Philosophical Association (APA), critical thinking is conceptualized to include both cognitive abilities as well as affective dispositions (Facione, 1989).

From this concept, Kong, Qin, Zhou, Mou and Gao (2014), developed a systematic review of the literature and a meta-analysis to estimate the effectiveness of problem-based learning in the development of critical thinking in nursing students.

Nine articles representing eight randomized controlled trials were included in the meta-analysis. Most studies were of low risk of bias. The pooled effect size showed that problem-based learning could improve critical thinking in nursing students (overall critical thinking scores SMD = 0.33, 95% CI = 0.13-0.52, P = 0.0009), compared to traditional classes. There was low heterogeneity (overall critical thinking scores I2 = 45%, P = 0.07) in the meta-analysis. No significant publication bias was observed with respect to the general critical thinking scores (p = 0.536). Sensitivity analysis showed that the result of the meta-analysis was reliable.

Most effect sizes for the subscales of the California Critical Thinking Disposition Inventory (CCTDI) and Bloom's Taxonomy favored problematized learning, while the effect sizes for all subscales of the California Critical Thinking Skills Test (CCTST) and most subscales of the Watson-Glaser Critical Thinking Assessment (WGCTA) were inconclusive.

Therefore, the results of the meta-analysis indicated that problem-based learning could help nursing students improve their critical thinking.

Similarly, Jeong (2003) examined group interaction and critical thinking in online discussions. He used the discussion analysis tool (DAT) to identify patterns in interactions and determine which ones promoted critical thinking. With DAT, discussion transcripts were coded across twelve critical thinking events, and the probabilities of transition between events were calculated using the sequential analysis method (Bakeman & Quera, 1995).

By calculating transition probabilities, DAT generated useful quantitative descriptions of interaction patterns and critical thinking events that followed. The findings showed that interactions involving conflicting viewpoints promoted greater discussion and critical thinking. The author concludes that tools such as TAD will be useful to empirically test interactions and structures that enhance online discussions.

**Emotional Intelligence**

According to the World Economic Forum Report (2016), one of the top ten skills or competencies that 21st century students must develop to enter the 4.0 industry job market is emotional intelligence.

Emotional intelligence has been defined as "a set of skills that enables us to make our way in a complex world: the personal, social, and survival aspects of general intelligence, common sense, and elusive sensitivity that are essential to effective daily functioning" (Stein and Book, 2011, p. 14).

Jameson, Carthy, McGuiness & McSweeney (2016) conducted research by applying an initial survey of employer opinions (n = 500) on the importance and current level of social and emotional competences of graduate students in five sectors: IT/computer science, professional services (including accounting, business, finance, human resources, law, retailing), science (including pharmaceutical and life sciences), and social sciences which are identified in industries in their growth stage in Ireland.

The aim was to explore the perspectives of employers to determine whether there are differences in social and emotional competency requirements among graduates in different employment sectors. The preliminary findings of the survey demonstrated a large disparity between the degree of importance, attributed by employers to emotional intelligence competencies and the actual levels shown by employees. This potentially represents a significant opportunity to allow students to develop the specific skills most favored by employers in their chosen career areas, which will likely increase their employability and success on the job.

**Personnel Management**

Recently, the focus in human resource management research has shifted from strategy to the concept of "high performance work" systems (Colombo, Delamastro & Rabbiosi, 2007, p. 1038).

Recently, empirical studies conducted by human resource management academics have attempted to map innovation performance in relation to human resource management practices. The study by Jiménez-Jiménez and Sanz-Valle (2005) on a range of Spanish companies examines how a company configures a human resource management strategy for innovation performance. In this study of 350 Spanish firms, they found that the strategy model of Schuler and Jackson (1987) appears to result in higher levels of innovation performance among the firms in the sample than in human resource management practices.

Another empirical study of Spanish firms conducted by Perdomo-Ortiz, González-Benito and Galende (2009) examines the use of human resource management practices associated with total quality management (TQM), called "TQM human resource management practices", and their impact on the innovation performance of companies. These include teamwork, extensive employee training, performance management, and measures to increase employee motivation. In particular, the authors analyze the use of these practices in packages. TQM's human resource management practices are very similar to the practices associated with high-performance work systems, so the study presents a useful proxy for the impact of high-performance work systems on innovation performance. The authors find a direct link between the use of packages in high performance jobs, systems practices and innovation performance. The strongest links in the study are between the use of teamwork (work organization) and measures to increase worker motivation. There is also a weaker direct link between the use of training and innovation.

**Coordination With Others**

Regarding this ability, Coskun, Kayikci & Gencay (2019), proposed a general framework for higher education focused on Industry 4.0, which consisted of three main components: curriculum, laboratory and student club to adapt engineering education to the vision of Industry 4.0. In the curriculum component, they determined the introduction of new study modules and changes to existing study modules. In the next step, they designed two main laboratories to address the changes they made in the curricula, namely the Visual

Production Laboratory and the Lego Laboratory. In defining the relationship between the course hours and the practical laboratory units, and how these laboratory units will be carried out, they used Kolb's Theory of Experiential Learning (2014). In the last step, they showed how a student club can complement the changes defined in the first two steps. Students can take the initiative for projects related to Industry 4.0 under the roof of a student club, which in turn supports the implementation of the active experimentation stage of Kolb's Theory of experiential learning. Preliminary results from the implementation of this framework at the German University of Turkey showed that it was feasible to apply this framework and the underlying theory adopted from Kolb to adapt engineering education to the vision of Industry 4.0.

Likewise, Hecklau, Galeitzke, Flachs and Kohl (2016), in their research mention that to face the challenges of knowledge and competence related to the new technologies and processes of the Industry 4.0, new strategic approaches are needed for the integral management of human resources in manufacturing companies. Due to the continuous automation of simple manufacturing processes, the number of workspaces with a high level of complexity will increase, which translates into the need for a high level of staff education. The challenge is to empower employees to shift their skills to more complex process activity spaces and ensure job retention in changing work environments. Although each job has different requirements, the competencies identified are increasingly important and must be addressed by human resource development.

**Service Orientation**

Pérez-Barco (2017) mentions that from now on this Fourth Industrial Revolution will be for highly qualified workers with a great capacity for adaptation, flexibility and continuous learning. Those with lesser training will be banished. "The technology market demands more multidisciplinary profiles, professionals with a curriculum in science, technology, engineering and mathematics (STEM) skills, either by university education or by a more technical profile from higher vocational training" (p.5).

The worker of the future must possess skills such as "collaborative and teamwork, time management, problem solving, analytical reasoning, ability to search, filter and prioritize information" (p. 9).

Similarly, the Fundación 1º de Mayo (2016) in its report emphasizes that "Hard skills should be taught in each specific situation and will revolve around understanding of systems, skills for machine tool changes, programming from the user level to more sophisticated programming skills. Soft skills are of utmost importance: flexibility, teamwork, learning ability, etc." (p. 7). From the point of view of technical content, it is clear "the need for hybridization of ICT skills or virtual environments with mechanics, mechatronics, systems engineering, programming, design, etc. fleeing from the hyper-specialization. From another point of view, organizational engineering must be complemented with management and organizational skills" (Cataldi, Donnamaria and Lage 2009, p.82).

**Negotiation**

According to Rao (2017), negotiation is the process of two people or groups resolving their conflicts or problems and achieving an acceptable solution. The role of the negotiator is to build trust in the stakeholders to resolve their differences by bringing them to common ground and achieving an outcome that benefits all.

The author mentions that in the era of Industry 4.0, negotiation skills are an integral part of soft leadership, because this leadership involves the use of persuasion and negotiation with the intention of achieving a win-win result.

**Judgment and Decision Making**

Over the past three decades, researchers interested in emotions and cognition have attempted to understand the relationship that affection and emotions have with cognitive outcomes, such as judgment and decision making. Recent research has revealed the importance of examining more discrete emotions, which show that emotions of the same value (e.g., anger and fear) have a differential impact as for instance judgment and decision outcomes. Narrative reviews of the literature (Lerner & Tiedens, 2006; Pham, 2007) have identified some under-researched issues, but provide a limited synthesis of recommendations.

Because of this, Angie, Conelly, Waples, and Kligyte (2011), conducted research that examines the influence of discrete emotions on the outcome of judgment and decision making and provides an assessment of observed effects using a meta-analytic approach. The results, in general, showed that discrete emotions have moderate to large effects on judgment and decision-making outcomes. However, the moderator analyses revealed differential effects for study design characteristics and emotion manipulation characteristics by emotion type.

**Research Question**

In relation to the above, it is imminent to investigate in depth, asking the following question:

- Which of the ten skills or competencies proposed by Hussin (2018), are developed from the Food Science and Technology Engineering Teaching Program (ICTA) to face the challenges of the Fourth Industrial Revolution or Industry 4.0?

## METHODS

The methodology used for this research was the application of a survey as a measurement instrument, which used an ordinal-type scale, or a discrete-type scale and was based on a five-point Likert scale of 1 (*Completely Disagree*), 2 (*Disagree*), 3 (*Neutral*), 4 (*Agree*), and 5 (*Completely Agree*), which collected the demographic data and the skills or competencies that the program helps students develop during their academic formation, confirmed by the graduates of Food Science and Technology Engineering regarding the acquisition of these skills or competencies, which the Fourth Industrial Revolution or Industry 4.0 demands.

The categories investigated were the ten skills or competencies demanded by the labor market of the Fourth Industrial Revolution or Industry 4.0, for graduates of any higher level educational program (Hussin, 2018).

In order to measure the reliability of the instrument due to the nature of its continuous variables (totally agree to totally disagree), the *Cronbach* alpha coefficient was used, which serves to check whether the instrument collects faulty information and, therefore, would lead to wrong conclusions or whether it is a reliable instrument that makes stable and consistent measurements (Creswell, 2008).

To this end, the instrument was piloted and applied to six teachers from different departments. The Alpha coefficient obtained was .85, which shows that it is a reliable instrument (Morgan, Reichert & Harrison 2002).

Once the reliability of the instrument was obtained, it was applied to a population of 60 graduates and 12 teachers assigned to the program. It is important to clarify that of the graduates of the ICTA program, only 14 responded to the survey, unlike the population of teachers, who responded in its entirety.

The reason why teachers and graduates of PDICTA were selected was in order to identify if the teachers are updated in their knowledge according to what is required by the Industry 4.0 and if so, up to what level they are teaching the graduates in this discipline of knowledge.

The data obtained from the surveys of both graduates and teachers of the ICTA program, were analyzed by the technique of descriptive statistics using the program *Statistical Package for the Social Sciences 19.0* (SPSS).

**Limitations**

One of the limitations is the participation and response by graduates and teachers in order to obtain a greater number of results, since not all those invited to participate responded positively.

The certainty that the participants in the study - the graduates of the teaching program (ICTA) - are clear about the meaning of the skills or competencies required by Industry 4.0, in terms of their preparation and whether they perceive the meaning of relevance.

## RESULTS

The survey was applied to all 34 full-time teachers of the PDICTA and was only answered by 12 teachers of whom 75% were men and 25% women, as shown in Table 1.

**TABLE 1**
**NUMBER OF PD TEACHERS BY GENDER WHO RESPONDED TO THE SURVEY**

| Gender | *f* | *%* |
|---|---|---|
| Male | 9 | 75 |
| Female | 3 | 25 |
| Total | 12 | 100 |

Source: Own elaboration (2019).

With regard to the academic degree of the teachers, as shown in Table 2, 8% have a bachelor's degree, 50% have a master's degree and 42% have a doctorate.

**TABLE 2**
**ACADEMIC DEGREE OF THE PDICTA TEACHERS**

| Degree | *f* | *%* |
|---|---|---|
| Bachelor's | 1 | 8 |
| Master's | 6 | 50 |
| Doctor | 5 | 42 |
| Total | 12 | 100 |

Source: Own elaboration (2019).

Likewise, the survey was applied to a population of 60 graduates who have maintained communication with the head of PDICTA since 2013; of this population, only 14 graduates responded to the survey of which 21% corresponded to the female gender and 79% to the male gender, as shown in Table 3.

**TABLE 3**
**NUMBER OF ICTA GRADUATES BY GENDER AND PERCENTAGE WHO RESPONDED TO THE SURVEY**

| ***Gender*** | ***f*** | ***%*** |
|---|---|---|
| Male | 11 | 78.6 |
| Female | 3 | 21.4 |
| Total | 14 | 100 |

Source: Own elaboration (2019).

It is worth mentioning that the graduates who participated in responding to the survey, from the date of their graduation, work in different subsectors of the food industry, distributed as follows: 28% work in food processing and conservation, 14% in packaging, 7% in the field of raw materials for food, while 14% work in food technology and 35% in dairy companies, as shown in Table 4.

**TABLE 4**
**DISTRIBUTION OF PDICTA GRADUATES BY BUSINESS**

| | *f* | *%* |
|---|---|---|
| Processing and conservation | 4 | 28.6 |
| Food packaging | 2 | 14.3 |
| Raw materials for food | 1 | 7.1 |
| Food Technology | 2 | 14.3 |
| Dairy | 5 | 35.7 |
| Total | 14 | 100 |

Source: Own elaboration (2019).

Descriptive statistical analysis using the SPSS 19.0 statistical package was used to answer the research question. The data obtained from this analysis, for each of the ten skills, from the survey applied to teachers and graduates of the PDICTA, are shown in Table 5 with their respective explanation.

**Analysis of Results**

Table 5 shows the results obtained from the descriptive statistics where the values of the variables that have more frequency are those that refer to the skills or competencies of complex problem solving, creativity, critical judgment and decision making, and cognitive flexibility. In other words, the value of the mode (Mo=4) showed that both teachers and graduates agreed that teachers supported graduates in the development of skills.

For the variables of critical thinking, personnel management, coordination with others, service orientation, negotiation, and emotional intelligence, among others, the results were expressed according to the rating scale provided 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree) and represented with the corresponding levels (Table 5).

According to the mode represented with a level or grade of 4 for the variables of complex problem solving, creativity, critical judgment and decision making, cognitive flexibility, service orientation, and negotiation, teachers agreed to have supported the development of these skills in the graduate (Table 5).

Analyzing the mode obtained from the descriptive analysis of the results of the graduates (Table 5), they establish with a maximum mode of 4 that the teachers participated in the development of the skills of the variables of solution of complex problems, creativity, critical judgment and decision making, cognitive flexibility, critical thinking, and emotional intelligence.

The teachers expressed with a mode of 2 (Table 5) that they did not consider the development of personnel management skills or emotional intelligence, however, in the case of the graduates they really affirmed that in the case of emotional intelligence it was developed in them by their teachers.

For the variables of personnel management, coordination with others, service orientation, and negotiation, graduates evaluated skill development with a mode of 3 (neutral), which indicates that they do not consider that their skills were developed (Table 5).

**TABLE 5**
**VALUES OF THE MODE OBTAINED FROM THE DESCRIPTIVE STATISTICS AS A RESULT OF THE SURVEY APPLIED TO THE TEACHERS AND GRADUATES OF THE PDICTA**

| **Skills or competences** | ***(Mo)* teachers** | ***(Mo)* graduates** |
|---|---|---|
| iComplex problem solving | 4 | 4 |
| Creativity | 4 | 4 |
| Critical judgment and decision making | 4 | 4 |
| Cognitive flexibility | 4 | 4 |

| | | |
|---|---|---|
| Critical thinking | 3 | 4 |
| Personnel Management | 2 | 3 |
| Coordination with others | 3 | 3 |
| Service orientation | 4 | 3 |
| Negotiation | 4 | 3 |
| Emotional Intelligence | 2 | 4 |

Source: Own elaboration (2019).

## CONCLUSIONS

From the results of the research, the following conclusions are presented taking into account the research question:

1. Based on the results of descriptive statistical analysis, PDICTA only covers four of the above skills (complex problem solving, creativity, critical judgment and decision making, and flexibility).
2. According to the analysis, in order to acquire the competences or skills for the solution of complex problems, creativity, critical judgment, decision making and flexibility, the graduates received support from the teachers.
3. Considering what Hussin (2018) mentions regarding the fact that graduates from higher education should have the 10 skills or competencies that Industry 4.0 demands to be incorporated into the labor market, it is concluded that PDICTA has a 40% advance in relative terms.

### Recommendations

The results of this study allow us to visualize the current situation of the teachers and graduates of PDICTA, in terms of the skills or competencies demanded by the Fourth Industrial Revolution or Industry 4.0.

In relation to the results obtained from the other skills (critical thinking, personnel management, coordination with others, emotional intelligence, service orientation and negotiation), it is clear that the university should consider updating the PDICTA's curriculum, so that it can meet the demands of Industry 4.0.

Further research is needed to determine the degree to which the findings of this study can be generalized to other academic programs and thereby identify whether they have the same level of skill or competency coverage as PDICTA in meeting the challenges of the Fourth Industrial Revolution or Industry 4.0.

It is recommendable to make a research with the population of the students of the PDICTA, to verify if the totality of the ten skills or competences is already covered, or if to achieve it, it is necessary to train the teachers and to acquire the competences for it.

Due to the heterogeneity of the university's educational programs, the results could not be generalized and their application would be exclusively applicable to the identified program.

The university should focus on updating the curriculum of this program in order to be prepared to face the challenges of Industry 4.0.

Finally, we see the need to sensitize teachers about the change that is emerging in the labor market globally, in the training of human talent to meet the challenges mentioned in the previous paragraph.

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