Creative Education, 2023, 14, 752-765
https://www.scirp.org/journal/ce
ISSN Online: 2151-4771
ISSN Print: 2151-4755

Vocational Education and Training with the Development of Soft Skills in STEM-Oriented Students from a Technological University in Partnership with a Mexican Manufacturing Company

Teresa Arias Ramos, María Amparo Oliveros Ruiz

Engineering Institute, Autonomous University of Baja California, Mexicali, Mexico
Email: teresaariasramos@gmail.com

How to cite this paper: Ramos, T. A., & Ruiz, M. A. O. (2023). Vocational Education and Training with the Development of Soft Skills in STEM-Oriented Students from a Technological University in Partnership with a Mexican Manufacturing Company. *Creative Education, 14,* 752-765.
https://doi.org/10.4236/ce.2023.144050

Received: March 30, 2023
Accepted: April 24, 2023
Published: April 27, 2023

Abstract

A descriptive, quantitative, non-experimental, transactional study is shown with the purpose of describing soft skills development in STEM-oriented students during their professional practices in the industry, by the Vocational Education System in a Mexican Technological University. The student's perception is analyzed on the multiple soft skills acquired during their professional practices, the advantages of the Vocational Education System compared to the Traditional Education Model, and the given knowledge to students through the university for the rich performance in company tasks. This research was done in a Mexican Manufacturing Company, where a structured survey was applied in the year 2021 to 81 students from a variety of academic programs of STEM disciplines in a Technological University located in Estado de Mexico. The technique used for data analysis was descriptive, where frequencies and percentages were processed on an Excel program; data was organized in graphs and represented as totals. Results showed that students managed to develop soft skills, on a larger scale teamwork, problem-solving, leadership, and communication.

Keywords

Vocational Education and Training (VET), Soft Skills, Technological University, STEM, Higher Education

1. Introduction

Higher education in Mexico must be aligned to the changing necessities of the

economy; due to the lack of talent emphasized by employers who estimate that the education and formation of job applicants do not meet their requirements and needs (ManpowerGroup, 2022); which obliges the Mexican Higher Education System to improve their relevance and results requiring a strategic vision aligned to the New Labor Market requirements (OECD, 2019).

Undoubtedly, access to higher education is increasing, in which the Organisation for Economic Cooperation and Development (OECD), observes that as if to keep the same trajectory, a quarter of the youth (26%) will earn some type of major degree throughout the course of their lives. Similarly, it also indicates that half a million graduates incorporate the Labor Market on a yearly basis and contribute to the global value chain (OECD, 2019).

The New Labor Market refers to the changes confronted by the technological advances, in which professional profiles are transitioning, appealing to digital competencies and abilities such as creativity, versatility, initiative, leadership, teamwork, critical thinking, and productivity, among others. To counteract these exigencies, STEM-oriented majors' qualifications (Science, Technology, Engineering, and Mathematics) become essential to the development of such professional profiles; among the desirable techniques, language learning prevails, design, mathematics, and engineering (Gogin et al., 2022).

In order to respond to the New Labor Market demands, technological education institutes are looking to adopt educational models such as the Vocational Education System, which is based on the student's enrollment in the labor market, in order to support the skill development of the student or apprentice. Among these soft skills, are such as: autonomy, self-learning, teamwork, effective and assertive communication, problem solving, and leadership (Fernández-Henajeros, 2022).

Furthermore, to comprehend the importance of "soft" skills is required to address the meaning of skills in general. According to Noe, Hollenbeck & Gerhart (2015), skills refer to the level of performance of an individual on a particular task of the capability to perform a job well which can be divided into technical elements and behavioral elements. In brief, hard skills are technical elements performed in a job, while soft skills are behavioral elements.

Naturally, soft skills are not technical aptitudes that are related to the way of working, interaction between coworkers, problem solving, and work confrontation. Up against technical abilities that are learned (hard skills), soft skills are interpersonal capacities that are developed through relationships with others (Flores Sánchez & Vigier, 2020).

Higher Education in technological universities in Mexico, which has adopted VET, were created to provide a proportional education based in the social-economic reality, the dynamics of diverse local labor markets, and favor the link between academy and productive sector (CGUT, 2006). To achieve this mission, VET expects to improve the development of the students' competences, find good reliable jobs, professionally grow, and keep themselves profitable for organizations and collaborators (Araya Muñoz, 2008).

The duality: academy and company, uses the fundamental principle admitting the company as a new school, where the student learned through the practice in situations and real life problems that may arise in a job position (Araya Muñoz, 2008).

The Vocational System is defined by Vega (2005: cited by Araya Muñoz, 2008) as a modality of vocational training, that goes through its process of teaching-learning in two different places, one in an educational institution where theoretical activities are practices, and other in an organization where productive-didactical activities are done.

Recent studies written by Flores Sánchez and Vigier (2020), Covarrubias Astorga (2018), and Rocha López and Alemán Macías (2019) were referenced. The analysis written by Flores Sánchez and Vigier (2020), as a conclusion shared that the graduates who participated in the dual system had a significantly higher salary and a less time for job collocation than the subjects who were not part of the program (traditional education). Meanwhile, Covarrubias Astorga (2018) analyzed how the dual vocational program in Baja California, Mexico has developed competences and new ways of learning for the dual students, and analyzed the changes on hiring practices, training, and evaluation of the participating companies in the cities of Mexicali and Tijuana. For their part, Rocha López and Alemán Macías (2019), carried out the study School-Company Program, antecedent of Dual Training: Case of the Technological University of North Aguascalientes (UTNA), Mexico, their results showed frequent activities and their relationship with the theoretical and academic contents of the study plans.

The analysis becomes necessary due to the requirements of the Mexican industry to detonate the economy with competent human resources that face the challenges presented by the current labor market (Covarrubias, 2018). Therefore, the objective of this analysis is to describe the soft skills developed during their involvement in professional practices in the industry, from students in the STEM area under the Dual Professional Training (FPD) model at a Mexican Technological University.

2. The National System of Higher Technological Education in Mexico

The National System of Higher Technological Education in Mexico dates to the end of the 19th century, and its momentum was seen towards the end of the 40s of that century, where the rise of technology demanded more and more specialized labor (Navarrete-Cazales, Granados, & Membrillo, 2020). Currently, in Mexico, the National System of Higher Technological Education is formed with the purpose of promoting the integral progress of the nation and consists of, according to the Ministry of Public Education (SEP), of four types of institutions: Centralized Technological Institutes and Decentralized, Technological Universities and Polytechnic Universities; includes the levels of higher university technician or associate professional (after the baccalaureate and prior to the degree,

which is oriented towards practice and subsequent obtaining of the corresponding degree), bachelor's degree (post-baccalaureate option, which culminates in obtaining a professional degree), and postgraduate, is the option after the bachelor's degree and includes the levels of: Specialization, Master's and Doctorate (DEGAIR, 2009; cited in Navarrete-Cazales et al., 2020).

Presently, Higher Technological Education has a great presence in Mexico, and its offer has been expanding according to the demand of the national and international labor market (Navarrete-Cazales, Granados, & Membrillo, 2020). According to data from the National Association of Universities and Institutions of Higher Education (ANUIES) with data from 2021-2022 school year, there is an enrollment of 905,549 students enrolled in public technological education institutions (224,812 enrolled in Technological Universities (UT), 103,922 in Polytechnic Universities (UP), and 348,750 in centralized units and 228,065 in decentralized units of the Tecnológico Nacional de México (TecNM) (ANUIES, 2022).

The appearance of technological education dates to the early sixties. At that time, higher education in the world experienced various changes, such is an example in France where the government, aware of the urgent need to train young people as Higher Technicians, gave rise to the creation of a professional graduation modality, which was established within the high schools and had a short duration, and had to be completed at the end of the year. Moreover, in 1966 the first Institutes Universitaires de Technologie (IUT) arose, with technological training designed around areas of knowledge applicable to various professional fields, with two-year programs.

In Mexico, it was not until the second half of the 19th century and the beginning of the 20th that the Professional Technical Training Centers (CFTP) emerged, which were developed in parallel to schools and universities (CGUT, 2006: p. 8). In 1930, given the diversity in the levels of education and the specialties of these Centers, most of them were grouped together. This is how the National Polytechnic Institute (IPN) was born in 1936. IPN included elementary professional training in the pre-vocational field, a level of higher technical studies and a series of programs especially dedicated to women and the workers (CGUT, 2006: p. 8).

2.1. Technological Universities in Mexico

According to the General Coordination of Technological Universities (CGUT, 2006), in 1989, the SEP began a transcendental program of evaluation and improvement of higher education that included all public universities and state institutions. Thus, in the study Strategy to Improve the Quality of Higher Education in Mexico (Report prepared for the Secretary of Public Education), published in 1991, Dr. Philip H. Coombs, president of the International Council for the Development of Education and founding director of the International Institute for Educational Planning of UNESCO, made a recommendation that led to the implementation of the Subsystem of Technological Universities, in such a

recommendation he suggested to the federal and state governments that they consider the possibility of increasing diversity in the Mexican higher education system creating well-planned, short-term, high-quality educational programs that will lead directly to attractive employment. With this recommendation, the Secretary of Public Education in Mexico authorized a project that promoted the definition of a pedagogical model, which crystallizes in a new option of higher education.

Additionally, after an analysis, it was concluded that operators and supervisors with better preparation were needed, less theoretical and more practical than graduates of bachelor's and engineering degrees from traditional universities. They demanded a desirable profile with a balance between technical skills focused on real industry processes, humanistic knowledge that ensures an acceptable cultural horizon, and communication and relationship skills within the work environment. Through the establishment of level 5B2 of the International Standard Classification of Education (ISCED), conceived by UNESCO at the beginning of the 1990s, a baccalaureate plus two years of study and focused on the practice and learning of specific skills was needed, to ensure collocation of the graduate in the job market immediately after graduation (CGUT, 2006: p. 8, 11).

Therefore, in Mexico, the Technological Universities are decentralized public bodies of the Governments of each state, nonetheless, they are integrated into a General Coordination of Technological Universities (CGUT) (Navarrete-Cazales, Granados, & Membrillo, 2020). These institutions were created with the purpose of decentralizing higher education services and favor marginalized communities; expand and diversify the educational offer by providing training in accordance with the socioeconomic reality and the dynamics of the various local labor markets; and favor the link between the academy and the productive sector. Consequently, these institutions sought to respond to the demands of an emerging economy, which needed human resources prepared to carry out the innovation that was required in the country. Its own individual objectives are to offer young high school graduates intense studies that allow them to integrate within a short period of time. Undeniably, ensuring the higher university technician the ability to perform successfully within a wide range of productive activities, as well as studies with certified quality throughout the stages of the educational process (CGUT , 2006: p. 12).

Currently there are 114 Technological Universities, in 31 states of the Republic. In these institutions there is the possibility of obtaining the title of Higher University Technician, Technical Engineer or Bachelor's degree (SEP, 2022).

2.2. Vocational Education System in Technological Universities in Mexico

The educational model based on competencies of the Technological Universities (UT) is oriented towards learning as a process throughout life; focused on the analysis, interpretation and good use of information (70% practice and 30%

theory). The UTs offer intensive training that allows them to join the productive market in just two years or continue with studies at a higher level, may be it a degree or a specialty (Navarrete-Cazales, Granados, & Membrillo, 2020). The UTs implement Dual Vocational Training (DVT) as an educational strategy, which is the combination of theoretical and practical learning. That is, the apprentice takes his explicit knowledge from the academic unit, to put it into practice through its insertion in the work environment. Likewise, DVT is conceived as a great opportunity to offer quality training and face some serious problems in societies such as school dropout and youth unemployment (Schmidt, 2010; Baethge, 2015).

In the UT, DVT combines the competences acquired in the educational spaces, with those acquired in the professional practice, strengthening and developing dual student aptitudes that will increase the possibilities of labor insertion. The learning process in the Economic Unit is alternated and complemented by training in the IES (UTSEM, 2022). The teaching-learning process is carried out in two different places: in the IES, where theoretical-practical activities are carried out and, in an organization, where they carry out didactic-productive activities that complement and alternate (UV, 2020); and it is carried out for a minimum period of one year in a company, with constant and specialized monitoring as well as having the figure of an academic mentor both in the IES and in the company (UTSEM, 2022).

DVT in Mexico has its main foundation derived from the fourth industrial revolution or industry 4.0 in which the use of technological resources and connectivity, among other factors, has meant for students to adapt to new circumstances of the social and economic environments, allowing their successful insertion in competitive and constantly changing work environments. Hence, this helps to solve problems that arise in the workplace, which allows them to learn collaboratively in a multidisciplinary environment (MRFDM, 2019; UV, 2020). Educational models are based on competency-focused learning, supported by pedagogical theories such as connectivism where the Internet connection and teamwork are essential, oriented towards self-learning, self-assessment, the main characteristic being team-based work with the use of technology, innovation and problem solving in real environments. For this reason, DVT seeks to close the gap between the human talent requirements of companies and the relevant educational offer of higher education institutions (HEIs) (Carvajal, Romero, & Álvarez, 2017; UV, 2020).

2.3. The New Labor Market

With the great advances in technology in recent decades, the different sectors of society have been influenced and forced to keep up with these technological changes, in such a way that the evolution of the Labor Market is no exception. The Labor Market is the point where labor supply and demand converge. Supply refers to the set of workers who are willing to work, and demand refers to the set

of employers who require the services. The proper functioning of supply and demand guarantees the economic growth of a country, and vice versa, its malfunction can have a negative effect (Paredes & Sonia, 2022).

When reference is made to the concept of the New Labor Market, it refers to changes in the technological aspects that the market is having. As is the case of Industry 4.0, which brings with it a new model of organization and control of the value chain, through the product life cycle and throughout the manufacturing systems supported and made possible by technologies of information (Del Val, 2020). Companies are required to understand the changes, challenges and opportunities brought by the new labor market, otherwise they may face loss of market share. These new conditions in the labor market are marking the appearance of new careers related to robotics, the use of Big Data, the Internet of Things, cybersecurity, the cloud and augmented reality, among others. The future presents changes in current professional careers derived from labor demand; however, all those disciplines related to STEM will register the lowest rate of decline (WEF, 2020).

These changes derived from the technological advances that have influenced the labor field, force a change in the profiles of the professions, demanding digital skills such as creativity, flexibility, initiative, productivity, among others. In STEM (Science, Technology, Engineering and Mathematics) careers, competencies become essential for the development of professional profiles demanded by the labor market. Among the required competencies, there is importance of languages, design, mathematics and engineering (Gogin et al., 2022). In addition to the demand for so-called soft skills, such as autonomy, self-learning, teamwork, effective and assertive communication, problem solving, and leadership (Fernández-Henarejos, 2022).

Academic institutions are often considered cutting edge centers for innovative ideas. Evidence available today, however, indicates that career incentives and funding conditions at universities currently favor conservative, incremental research programs over bold, innovative ones (Bautista-Vallejo, Duarte de Krummel, Hernández-Carrera, & Espigares-Pinazo, 2020). Therefore, DVT becomes the propitious space for the development of student skills to guarantee that technological advances, innovation, entrepreneurship, among others, continue (Bautista-Vallejo et al., 2020). Thus, we see that DVT, through the insertion of the student in the labor field, contributes to the development of soft skills (Fernández-Henarejos, 2022).

2.4. Soft Skills and the 4.0 Industry

The 4.0 industry introduced by Klaus Schwab in the 2016 World Economic Forum edition has the characteristic that differs from previous industrial revolutions, due to the way things are done and the fusion of technology with biology. Among the topics of this fourth revolution, we identify activities such as: manufacturing with 3D printers, horizontal and vertical integration systems, cyberse-

curity, augmented reality, cloud computing, autonomous robots, artificial intelligence, blockchain, industrial internet of things, business intelligence, big data and analysis, simulation (Cortés, Landeta, Chacón, Pereyra, & Osorio, 2017).

Technology advances exponentially every day and the ability of humans to assimilate all this information and new technology is complex. The case of McKinsey is an example, which predicts that by the year 2030, close to 375 million jobs can be automated. Despite the fears that prevail when each of these revolutions occur, it is being verified that, in some countries, surprisingly, unemployment is decreasing, an action achieved by the total support of the United States government to increase the qualification people and work much more on the so-called "Soft Skills". According to (World Economic Forum, 2020) "The Future of Jobs", professionals for the same year must have the following ten soft skills highly developed: problem solving, critical thinking, creativity, personnel management, teamwork, emotional intelligence, judgment and decision making, service orientation, negotiation, and cognitive flexibility.

These skills are what will differentiate professionals to be able to compete with robots and automation, which will focus on repetitive tasks. It is necessary for human beings to be more and more human and this is what will largely differentiate them (Patiño Borda, 2022).

3. Method

The methodological design contemplated a method with a quantitative, non-experimental, cross-sectional approach, with a descriptive scope (Hernández, Fernández, & Bautista, 2014). The research was carried out in a Mexican manufacturing company, where a survey was carried out, supported by the design of a structured questionnaire with multiple choice questions (Hernández et al., 2014), which was applied in 2021 to 81 students from different academic programs in the STEM area at a Technological University located in the State of Mexico, under the FPD program. The sample considered 100% (81) of the students who were enrolled in the year 2021. The variables analyzed were the type of soft skills acquired, the advantages of the Dual Vocational Training Model compared to the Traditional Training Model, and the knowledge provided to students by the educational institution attached to DVT, for the performance of their tasks in the company. The data analysis technique was descriptive, frequencies and percentages processed in the Excel program were obtained. The data was organized in graphs and correspond to the totals. Accordingly, a self-administered questionnaire sent by mail was applied; allowing access to students who live at a distance and providing the facility to respond when the respondent has an opportune moment.

The questionnaire was structured in three parts, the first includes the general information of the students under the VET program; the second corresponds to business and academic involvement, and the third refers to the acquisition of Knowledge and skills by students. It consisted of thirty (30) closed questions,

applied to all apprentices registered in 2021.

According to (Martín Arribas, 2004), validity conforms: "the degree to which a measurement instrument measures what it really intends to measure or serves the purpose for which it was built. It is about submitting the questionnaire to the evaluation of researchers and experts, who must judge its capacity to evaluate all the dimensions that we want to measure." Therefore, to achieve the validity of the instruments applied in this study, the opinion of three (03) professionals in the area of research methodology, with extensive experience in the preparation of questionnaires and interviews, was consulted.

4. Results

The descriptive results of 81 surveys applied in 2021 to students in the STEM area trained through the dual program who were attached to a Mexican Technological University in a collaboration agreement with a company in the manufacturing sector, located in the State of Mexico, are presented. The general data is described as the age range of the participants, the percentage of participation of the STEM careers in the Dual Professional Training Model by Academic Program, mentoring received within the company; as well as the identification of the skills developed by the students during the time of their participation in the dual training program, the advantages of the dual professional training model with respect to the traditional education model, and the knowledge granted by the educational institution of affiliation to students under the dual program, for the performance of their activities.

General data. Regarding the age range, most of the students surveyed are in the range of 15 to 20 years of age, representing 67.9% (55), followed by the range of 21 to 25 years with 29.6%. (24), and 2.5% (2) in the range of 26 - 30 years. The students belonging to majors in the STEM area, all of them engineering: Mechatronics Engineering (48.1%, 39), Industrial Engineering (23.5%, 19), Industrial Manufacturing Processes (24.7%, 20) and Manufacturing Technologies (3.7%, 3) (see **Figure 1**). The results corroborated that the students receive the instruction and the appropriate follow-up by the mentor in the company to which the student is assigned as part of the Dual Training Program, in this regard 100% (81) of the apprentices answered affirmatively, all of them receiving mentoring within the company.

Skills developed by students under the VET System. The results of the skills that the students of the STEM area managed to develop during their career at the University-Business with VET in project, indicated that the most representative skills acquired in the workplace were teamwork (22%, 65), problem solving (18.3%, 54), leadership (15.3%, 45) and communication (14.6%, 43); being well below creativity (6.8%, 20), an element indicated as necessary by Rauner, a researcher at the University of Bremen (see **Figure 2**).

Advantages of the Vocational Education System. In relation to the opinion of the students regarding the advantages of the VET program with respect to the

traditional education model, 39.5% (32) believe that in the VET program, unlike the traditional education model, has more solid knowledge, since the student learns by doing; they have broader opportunities in the labor market (29.6%, 24), because they perceive themselves to be more competitive; and 19.8% (16) believe that they discover skills on their own that they did not think they had, that is, the student's self-discovery of skills (see Figure 3).

Knowledge provided by the educational institution to students under the Vocational Education Program from the students' perspective. The majority of the surveyed, 64.2% (52) indicates that they receive all the theoretical knowledge from the school to take over and apply tasks in the company; 22.2% (18) comments that the majority of times knowledge is received from the school; and 12.3% (10) answered that not always, because the company provides the required training; finally, 1.2% (1) indicates that no knowledge was provided from schooling but the company provided all training (see Figure 4).

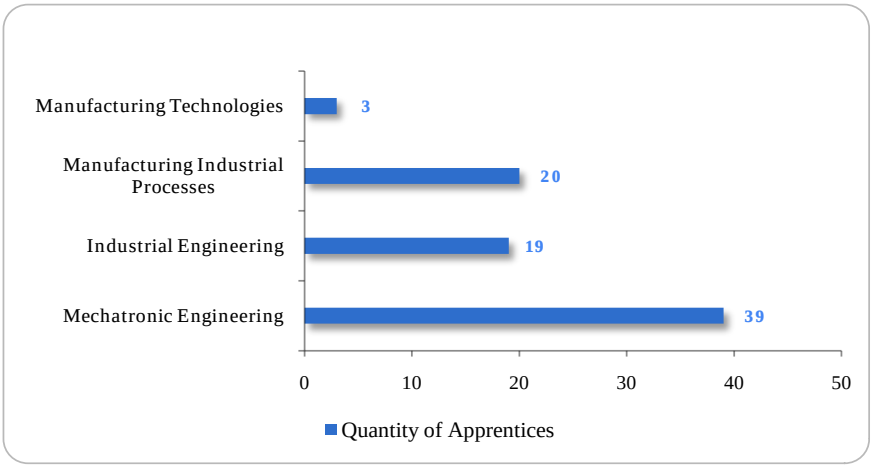

Figure 1. Quantity of apprentices per academic program.

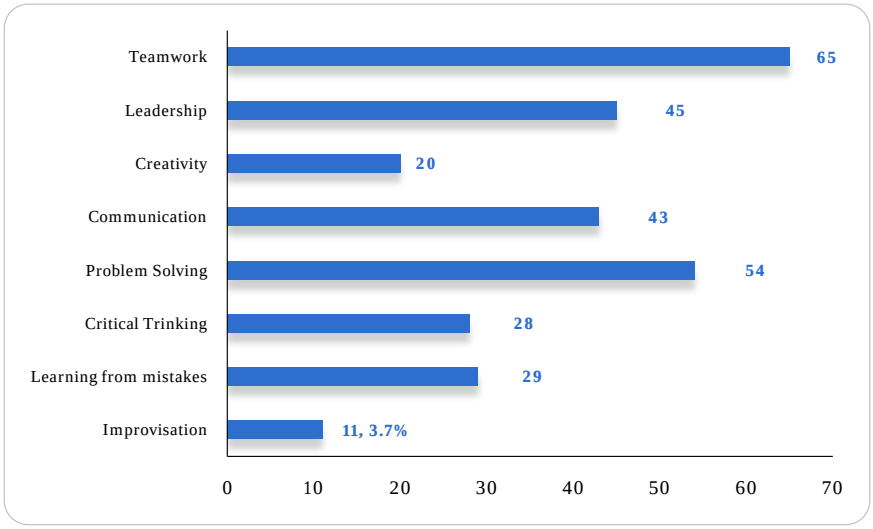

Figure 2. Skills developed by students under the VET system.

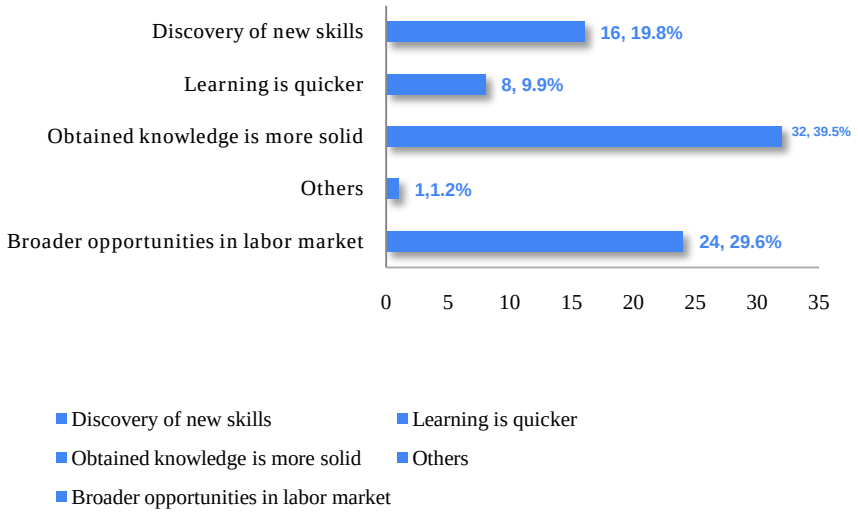

Figure 3. Advantages of the vocational education system from the students' view.

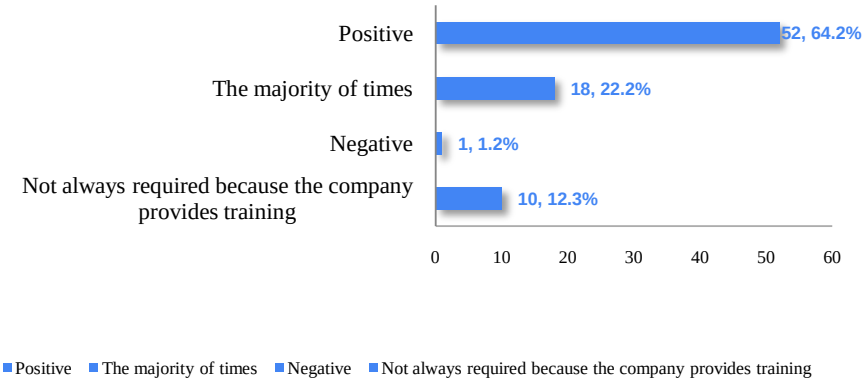

Figure 4. Knowledge provided by the educational institution to students under the Vocational Education Program from the students' perspective.

5. Discussion

Due to the complexity of the present study, several limitations were met, such as the lack of participants in the program in Mexico, and the hesitation of several universities to share its data bases. These limitations were surpassed by contacting several universities until the one chosen agreed to disclose its database.

Derived from the analysis carried out on the survey applied to students training at a Mexican Technological University for Careers in the STEM area, it is stated that the results are highly positive regarding the implementation of the FPD program.

According to the results, the students managed to develop soft skills to a greater extent such as teamwork, problem solving, leadership and communication.

The Dual Vocational Training Model (FPD) with respect to the Traditional Training Model, showed opinions about the advantages of the FPD in terms of the solidity of the knowledge acquired and the greater employment opportuni-

ties. Likewise, the students consider that they discover abilities that they did not know they had and that the learning process is faster, thanks to the application of theoretical knowledge.

Another of the points observed was the mentoring and knowledge that the students receive both from the Institution of Higher Education to which the former is attached, as well as from the company. In the first case, the majority indicated that they receive all the theoretical knowledge from their university; however, 100% was not obtained, since, in some cases, it is suggested that the company provided the required training. Regarding the knowledge acquired in the company, all the respondents answered that they did have the appropriate mentoring within the workplace where they did their stays.

Replicating the dual professional training model is presented as a good alternative for student learning and their early approach to the professional field; as well as comply with the requirements regarding the development of soft skills that are essential for higher education graduates to acquire when entering the labor field and meet the expectations of their employers.

The findings demonstrate that soft skills are not to be ignored or diminished over hard skills. New jobs require a higher sense of behavioral ability due to the changing market and technology. Therefore, the need to produce "more human" human resources, is standardly met through the application of Vocational Educational Training systems. The relevance of this study is undoubted as it gives a solution to a more capable and efficient human resource. The implementation of VET guarantees industries and universities the competence of their apprentices/employees.

Acknowledgements

Autonomous University of Baja California, in collaboration with a Mexican Manufacturing Company.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Araya Muñoz, I. (2008). La formación dual y su fundamentación curricular. *Revista Educación, 32,* 45-61. https://www.redalyc.org/pdf/440/44032105.pdf

Asociación Nacional de Universidades e Instituciones de Educación Superior (ANUIES) (2022). *Estadística de Educación Superior, Ciclo escolar 2021-2022.* http://www.anuies.mx/iinformacion-y-servicios/informacion-estadistica-de-educacion-superior/anuario-estadistico-de-educacion-superior

Baethge, M., & Wolter, A. (2015). The German Skill Formation Model in Transition: From Dual System of Vet to Higher Education? *Journal for Labour Market Research, 48,* 97-112. https://labourmarketresearch.springeropen.com/articles/10.1007/s12651-015-0181-x

Bautista-Vallejo, J. M., Duarte de Krummel, M., Hernández-Carrera, R. M., & Espigares-Pinazo, M. J. (2020). Research at the University Today. Notes for Educational Leadership and Social Change. *Revista Científica de la UCSA, 7,* 39-48. https://doi.org/10.18004/ucsa/2409-8752/2020.007.01.039-048

Carvajal, R. P., Romero, A. J., & Álvarez, G. (2017). Estrategia para Contribuir a la Implementación de la Formación Dual de los Profesionales de Ciencias Empresariales en las Pequeñas y Medianas. Empresas de la Provincia Tungurahua, Ecuador. *Formación Universitaria, 10,* 29-40. https://doi.org/10.4067/S0718-50062017000500004

Coordinación General de Universidades Tecnológicas (CGUT) (2006). *XV años Universidades Tecnológicas. Capítulo I. Histo-ria de las Universidades Tecnológicas.* https://dgutyp.sep.gob.mx/Publicaciones/DGUTyP/LibroXVUUTT/CAPITULO_I/Capitulo_I.pdf

Cortés, C. B. Y., Landeta, J. M. I., Chacón, J. G. B., Pereyra, F. A., & Osorio, M. L. (2017). El Entorno de la Industria 4.0: Implicaciones y Perspectivas Futuras. *Conciencia Tecnológica, 54,* 33-45.

Covarrubias Astorga, L. G. (2018). *El modelo de formación dual de baja california: ¿una nueva forma de articulación entre educación y empleo?* MSc. Thesis, El Colegio de la Frontera Norte. https://www.colef.mx/posgrado/wp-content/uploads/2018/10/TESIS-Covarrubias-Astorga-Lilia-Guadalupe.pdf

Del Val, J. L. (2020). Industria 4.0: la transformación digital de la industria, Reporte de Conferencia de Directores y Decanos de Ingeniería Informática.

Dirección General De Acreditación, Incorporación Y Revalidación (DEGAIR) (2009). La Estructura del Sistema Educativo Mexicano. Unidad de Planeación y Evaluación de Políticas Educativas-SEP. México. https://www.sep.gob.mx/work/models/sep1/Resource/1447/1/images/sistemaedumex09_01.pdf

Fernández-Henarejos, A. C. T. (2022). *Diseño, implementación y evaluación de un programa formativo en la empresa en el marco de la formación profesional dual.* Ph.D. Thesis, Universidad de Murcia.

Flores Sánchez, G. G., & Vigier, H. P. (2020). El Impacto del Modelo educativo dual en la formación profesional del estudiante. *Revista Colombiana de Educación, 78,* 173-205. https://doi.org/10.17227/rce.num78-9535

Gogin, H., Andres, E. et al. (2022). *Ingeniería de Productos y Servicios-GE69-202101.* Universidad Peruana de Ciencias Aplicadas (UPC). https://repositorioacademico.upc.edu.pe/handle/10757/664387

Hernández, S. R., Fernández, C. C., & Baptista, L. P. (2014). *Metodología de la Investigación.* McGraw Hill.

ManpowerGroup (2022). *ManpowerGroup Employment Outlook Survey Q4.* https://go.manpowergroup.com/hubfs/MEOS/2022_Q4/Global_EN_MEOS_Report_4Q22.pdf

Martín Arribas, M. C. (2004). Diseño y validación de cuestionarios. *Matronas Profesión, 5,* 23-29. https://www.enferpro.com/documentos/validacion_cuestionarios.pdf

MRFDM (2019). Marco de Referencia Para La Formación Dual En la Educación Superior en México, Formación Dual En La Educación Superior. SEP, FESE y ANUIES. https://issuu.com/fesemx/docs/marco_de_referencia_formacio_n_dual

Navarrete-Cazales, Z., Granados, H. M. M., & Membrillo, M. G. L. (2020). El Sistema Nacional de Educación Superior Tecnológica en México: Políticas y estructura. *Revista de Estudos em Educação e Diversidade-REED, 1,* 320-338.

https://doi.org/10.22481/reed.v1i2.7898

Noe, R. A., Hollenbeck, J. R., & Gerhart, B. (2015). *Fundamental of Human Resource Management.* McGraw-Hill.

Organisation for Economic Cooperation and Development (OECD) (2019). *Higher Education in Mexico: Labour Market Relevance and Outcomes.* https://www.oecd.org/fr/publications/higher-education-in-mexico-9789264309432-en.htm

Paredes, P., & Sonia, M. (2022). *Ingeniería para la Innovación-GE 74-202102.* Universidad Peruana de Ciencias Aplicadas (UPC). https://repositorioacademico.upc.edu.pe/handle/10757/664333

Patiño Borda, F. J. (2022). *Tecnología e Innovación en el Futuro del Trabajo: Escenarios en el Empleo Público en el Perú al 2030.* MSc. Thesis, Pontificia Universidad Católica del Perú. https://tesis.pucp.edu.pe/repositorio/handle/20.500.12404/23575

Rocha López, M., & Alemán Macías, L. E. (2019). Programa escuela-empresa, antecedente de formación dual: Caso Universidad Tecnológica del Norte de Aguascalientes, México. *Quipukamayoc, 27,* 91-96. https://doi.org/10.15381/quipu.v27i54.16263

Schmidt, C. (2010). Vocational Education and Training (VET) for Youths with Low Levels of Qualification in Germany. *Education + Training, 52,* 381-390. https://www.ingentaconnect.com/content/mcb/004/2010/00000052/00000005/art00003

Secretaría de Educación Pública (SEP) (2022). *Universidades Tecnológicas.* https://educacionsuperior.sep.gob.mx/u_tecnologicas.html

Universidad Tecnológica del Sur del Estado de México (UTSEM) (2022). *Modelo Educativo: Educación Dual.* https://utsem.edomex.gob.mx/educacion-dual

Universidad Veracruzana (UV) (2020). *Modelo de Formación Dual en la Universidad Veracruzana.* https://www.uv.mx/tecnica/files/2021/01/Guia-Formacion-DUAL-UV-2020.pdf

World Economic Forum (WEF) (2020). *The Future of Jobs Report 2020.* http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf