

Impact of the dual training model on graduates of technological degrees: Case of The Technological University of the South of the State of Mexico [2019-2024]

Impacto del modelo de formación dual en egresados de carreras tecnológicas: Caso Universidad Tecnológica del Sur del Estado de México [2019-2024]

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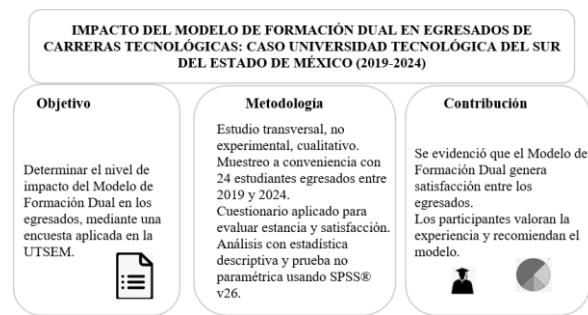
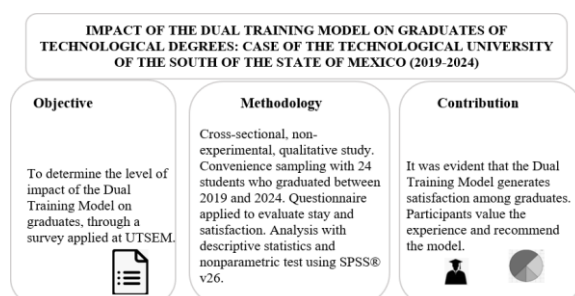


Abstract

Objective: To determine the level of impact of dual training on participating graduates by conducting a survey to measure its reach at UTSEM. **Methodology:** A cross-sectional, non-experimental, qualitative study with convenience sampling. A questionnaire was administered to 24 students participating in the Dual Training Model from 2019 to 2024, collecting data on their experience and assessing their satisfaction. The analysis was conducted using descriptive statistics and a nonparametric test, using SPSS® v26. **Results:** Of the responses, 62.5% were graduates of the Information Technology program, 20.8% of the Food Processing program, and 16.7% of the Mechatronics program. The students participated due to the experience gained and are satisfied with the model. **Conclusion:** From 2019 to 2024, more than 50 students participated in this program. The students participated due to the opportunities the model offers and recommend it.

Resumen

Objetivo: Determinar el nivel de impacto de la formación dual en los egresados participantes aplicando una encuesta que dimensione el alcance tenido en la UTSEM. **Metodología:** Un estudio transversal, no experimental, cualitativo con muestreo a conveniencia. Se aplicó un cuestionario a 24 estudiantes participantes en el Modelo de Formación Dual de 2019 a 2024, recolectando datos sobre su estancia y evaluando su satisfacción. El análisis se realizó con estadística descriptiva y prueba no paramétrica, empleando SPSS® v26. **Resultados:** De las respuestas, 62.5 % fueron egresados de la carrera de Tecnologías de la Información, 20.8 % de la carrera de Procesos Alimentarios y 16.7 % de la carrera de Mecatrónica. Los estudiantes participaron por la experiencia obtenida y están satisfechos con el modelo. **Conclusión:** Desde 2019 hasta 2024, más de 50 estudiantes participaron en este programa. Los estudiantes participan por las oportunidades que ofrece el modelo y lo recomiendan.



Survey, Dual Training, Satisfaction

Encuesta, Formación Dual, Satisfacción

Area: Dissemination and universal access to science

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Introduction

In Mexico, bachelor's degree programmes offered by public and private universities, technological institutes, and other institutions were in high demand at the end of the 20th century, so much so that they became insufficient to meet the requirements of industry [Weiss and Bernal, 2013]. In the 1980s, a project emerged that gave rise to the Technological University [UT] model, as a proposal to expand Dual Training Model.

The background of the dual model dates back to the Middle Ages, with origins in the craft guilds developed in Central Europe, based on the idea of 'learning by doing' under the supervision of a master. The system gave rise to the combination of education and production educational opportunities and respond to the changing situation in the country. This pedagogical model, which guided the teaching of courses at UTs, was characterized by the attributes of quality, relevance, intensity, continuity, versatility and flexibility [La Coordinación General de Universidades Tecnológicas, 2006], offering the title of Senior University Technician [TSU]. The boom was significant, and they quickly spread to several states across the country.

The result was the training of professionals with two years of preparation, responding to the needs of the industrial sector. Currently, 114 technological universities are located in the 31 states of the Mexican Republic, offering two degrees, one in TSU and the other in Engineering [Undersecretary of Higher Education, 2024], which arose from the demands of graduates to have access to higher positions in a company. In this model, links with companies are vital to ensure the practical part of the training is fulfilled, the internship, which is the student's first contact with the labour market.

The background to technological education in Mexico includes the educational models of European and North American nations. The need to cover the industrial sector and the diversification of work were factors that influenced educational policies in the last decades of the last century [Ruiz-Larraguivel, 2011] and today, the technological model has been strengthened over the last few decades, offering greater areas of knowledge.

Education is an indispensable factor for the development of economies and, therefore, for adapting to changes and new needs. In recent years, Mexico has adopted models that enable it to meet these needs. However, due to political, economic and social changes, education currently plays an important role as a catalyst for economic recovery. The amendments to the Political Constitution of the United Mexican States and the policies set out in the National Development Plan, as well as the United Nations [UN] 2030 Agenda for Sustainable Development, are in a way steering the course our country is taking with the change of government [Rodríguez, 2020].

One necessity arising from this policy is the need to train qualified professionals who will foster the relationship between businesses and educational institutions, hence the emergence of the Mexican through adaptations during the 19th and 20th centuries [Ruiz-Larraguivel, 2011].

The current dual vocational training system originated in Germany. Companies demanded changes in university education and called for greater integration of theory and practice [Palos and Herráiz, 2022], and companies such as Bosch and Daimler-Benz promoted this model. This is where the term 'dual' comes from [Morales Ramírez, 2014].

The duality of academia and business involves seeing the company as a new school, where students learn through practice in real-life situations or problems in the workplace and, by applying theoretical principles, achieve the transformation of reality [Palos and Herráiz, 2022]. In 2013, the German government made a proposal to share its experience with the dual system with interested partner countries. Thus, in 2016, European Union countries adopted the structures of the dual vocational training system. Other countries, including Mexico, are also adopting this working model [Lüber, 2022].

Dual training allows for the expansion of vocational training opportunities [Flores-Sánchez and Vigier, 2020]. The interaction between theory and practice facilitates the acquisition of skills. On the one hand, students learn interdisciplinary skills such as management, leadership and strategy, which are necessary in the increasingly complex world of work; and on the other hand, they develop personal skills such as the ability to analyze, evaluate and systematise.

It has also been observed that students acquire professional communication skills [Palos and Herráiz, 2022; Sánchez Cervantes et al., 2024].

Student learning in a practical environment is only one element of the dual model. In addition, there is a close connection between social partners, business organizations and the state, national quality standards for training content and teaching staff, and continuous evaluation [Lüber, 2022]. As a result, the dual model has been extended to several institutions, both higher education and upper secondary education, in our country [Secretaría de Educación Pública, 2014]. In the case of technological universities, incorporation begins in the fourth semester at the Higher Technical University level and in the ninth semester at the Engineering level. Thus, through collaboration, the skills acquired in educational spaces are combined with work or professional practice, which allows for the strengthening and development of aptitudes, promoting better conditions for their entry into the labour market or professional life [Government of the State of Mexico, 2019].

The Technological University of the South of the State of Mexico [UTSEM] was created in 1997 as an alternative training model consistent with the social and productive needs of the region [Technological University of the South of the State of Mexico, n.d.]. Initially offering the Higher Technical University model, in 2009, with the modification of the study plans, it extended the continuity of engineering-level studies.

The Dual Training Model at UTSEM was implemented in 2019 in accordance with the provisions established by the Government of the State of Mexico. The Mechatronics, Information Technology and Food Processes programmes, at both the Higher Technical and Engineering levels, needed to establish links with the productive sector by creating agreements to implement this model. Likewise, the government established cooperation and support links with companies located in the territory to place students in dual training [Government of the State of Mexico, 2019].

From 2019 to 2024, UTSEM has had engineering and higher technical university level students in dual training in companies in the State of Mexico and other states.

This cross-sectional study aims to determine how dual training has impacted participating students and their relationship with the workplace.

By applying a survey and conducting a correlational analysis, the study aims to gauge the scope of the implementation of this model at UTSEM, as well as to make a projection for extending it to future generations.

Methodology

This is a cross-sectional, non-experimental, qualitative study with convenience sampling. The key variables to be measured were identified, such as the students' experience in the company during their participation in the Dual Training Model; their perception of the skills developed and knowledge learned; difficulties encountered during their participation; as well as their overall perception during the period in the company and their satisfaction.

Sample selection and survey design.

All students in the Food Process Engineering, Mechatronics, and Information and Communication Technologies programmes who participated in the Dual Training Model from 2019 to 2024 at the TSU and engineering levels were selected.

Questions were formulated related to identified variables [Table 1 in the annexes] and were grouped in a logical and coherent manner to facilitate understanding and response by the respondents. Likert scales were used in some questions to measure perceptions on a scale of 1 to 5 [1 very poor, 2 poor, 3 average, 4 good and 5 excellent], as well as open-ended questions to obtain more detailed information. The survey consisted of 21 questions in electronic format, which were sent by email obtained from the UTSEM technology degree database.

The online platform Google Forms was used to administer the survey and reduce the time required to complete it. The survey was conducted during April and May 2024. Participants were given instructions on how to complete the survey and assured that their responses would be used solely for research purposes, maintaining confidentiality.

Data analysis. We began with a descriptive analysis of the variables, calculating frequencies and percentages for the responses to the closed questions [response frequency/total responses*100]. This analysis allowed us to examine the distribution of responses and the prevalence of certain opinions or perceptions among participants. Open-ended questions were divided into keywords, classifying responses according to the extent to which they mentioned the word. For Likert scale questions, the means and standard deviations corresponding to each were calculated. This provided a measure of the central tendency and dispersion of responses.

In addition, the non-parametric Kruskal-Wallis H test was performed to explore possible differences between groups [a non-parametric statistical test used to compare three or more independent groups and determine whether they come from the same distribution or whether there are significant differences between them; it does not require the data to follow a normal distribution]. The null hypothesis was that there was no variability between the scores of the participating courses at an α of 0.05. SPSS® version 26 was used for the statistical analysis.

Results

The electronic form was sent to 52 students registered at the university as participants in the Dual Training Model until 2024. A total of 24 responses were recorded, corresponding to students from the degree programmes included in the study and taught at UTSEM. Twenty-eight did not respond to the survey. Table 2 shows a summary of the characteristics of the respondents.

Box 1

Table 2

Descriptive data on participants

Distribution of responses	62.5% Technology 20.8% Food Processing 16.7% Mechatronics	Information
Sex	62.5 % men 37.5 % women	
Level at which they participated	20.3 % in TSU 16.7 % in both	

The responses were obtained from students enrolled in TSU or Engineering programmes between September 2019 and April 2024.

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The most representative percentages were 67% for 2023 and 16.7% for 2019. Others were 8.3% in 2021 and 8.3% in 2022. There were no responses from 2020 and 2024. In 2020, due to the Covid-19 pandemic, the incorporation of students into the programme was suspended, and those who were already enrolled were withdrawn for health reasons.

Normally, the programme enrolment period is in September, so when this study was conducted in April-May, the call for applications for 2024 had not yet been opened. It is important to mention that the selection of students to participate in the programme meets certain criteria, such as: their interest in participating after an introduction to the model, a socio-economic study and a psychological study, all of which are carried out at the university. Another criterion is an interview with the company's human resources department.

The preliminary selection is made by direct invitation to students who are regular university students and have outstanding academic performance. The students' graduation average confirms the above, with 69.6% having an average above 9.0 and the rest having grades between 8 and 8.9. The university has records showing that engineering students decide to participate in the programme in order to seek better job opportunities upon graduation.

In the open-ended questions, students were asked about some important aspects of their participation in the programme. In response to the question, **What were your reasons for joining the Dual Training Model?** the answers were classified into the following keywords: opportunity, experience, knowledge and work.

The search for experience was the most frequently mentioned, with 17 responses, followed by knowledge [4], opportunity [2] and work [1]. One response stood out: 'The reasons I decided to stay in the Dual Model are because the company I work for offers many opportunities to build on what I learned at university and to acquire new knowledge.'

When asked, 'How did you decide to participate in the Dual Training Model?', several points were taken into account, among the most important of which were future prospects, acquiring more knowledge, the advantages offered by the model, opportunity, convenience, experience, and mere personal interest.

One student's contribution stands out: 'The main reason was to gain experience and the opportunity for growth in the company.'

When asked if they received financial support during their stay, 70.8% said that the company provided support and 29.2% said no. Satisfaction during the stay at the company is important because it shows how satisfied the student was. In response to the question, 'How would you rate your stay at the company where you were collaborating in the Dual Training Model?', the Likert scale showed that more than 80% were satisfied with good to excellent. Figure 1 shows a graph illustrating the responses on the scale. More than 80% rate their participation as good to excellent.

Box 2

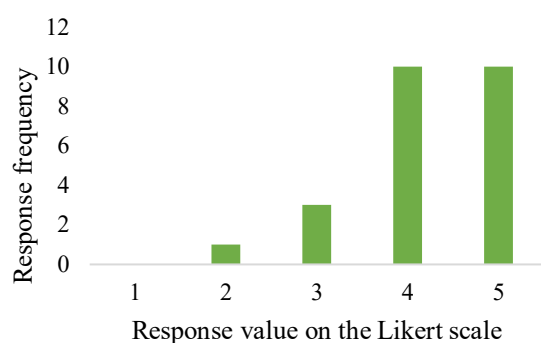


Figure 1

Evaluation of the stay in the company

In the question, How was your learning in the company, referring to learning in general, not distinguishing between knowledge, more than 80 % indicated that it was good to excellent, as can be seen in figure 2

Box 3

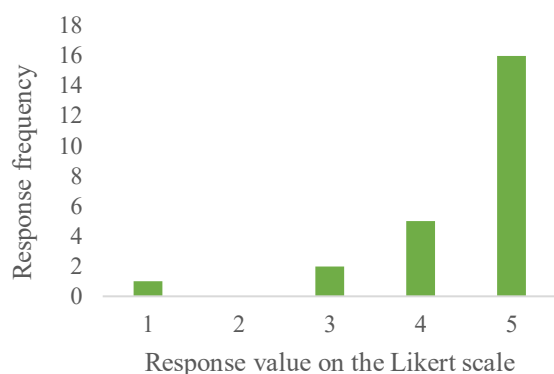


Figure 2

Satisfacción del aprendizaje en la empresa

Regarding knowledge training [knowledge], the question: How do you rate your knowledge training in the company, more than 90 % rate it as fair to excellent. Figure 3 shows the scale of responses.

Box 4

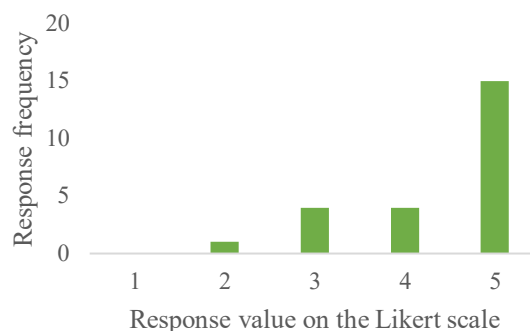


Figure 3

Satisfaction with knowledge formation

For the evaluation of the know-how developed during the stay in the company during the participation, with the question "How do you rate your know-how skills with respect to your professional profile? 79.2 % rate this participation from good to excellent".

Box 5

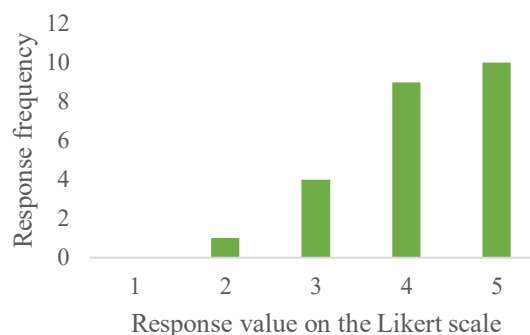
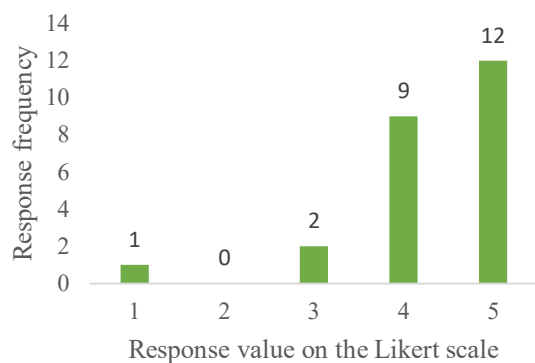


Figure 4

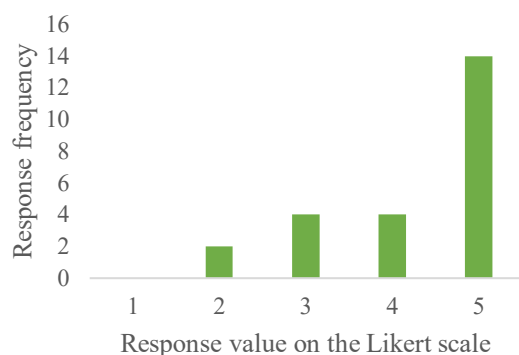
Satisfaction with know-how skills according to the professional profile

For the evaluation of the Self, 2 questions were asked: How do you rate your personal ability to cope in the current working environment? and How do you rate your personal development during your stay in the company? in both questions 87.5 % between good and excellent were mentioned.

Box 6**Figure 5**

Satisfaction regarding personal skills and personal development

With the question **"How satisfied are you with the company in which you participated in the Dual Training Model?"**, the Likert scale showed that 58.3 % rated it as excellent, 16.7 % as good, 16.7 % as fair and 8.3 % as bad.

Box 7**Figure 6**

Satisfaction with the company

We see that most participants rated their stay as good to excellent, but the percentage that rated it as poor would be a point to review in order to better monitor participation in the model. In the Likert scale questions, using the Kruskal-Wallis test to compare groups [degree programmes] to see if there was a difference, the result showed that there is no difference between the groups; the responses are highly similar.

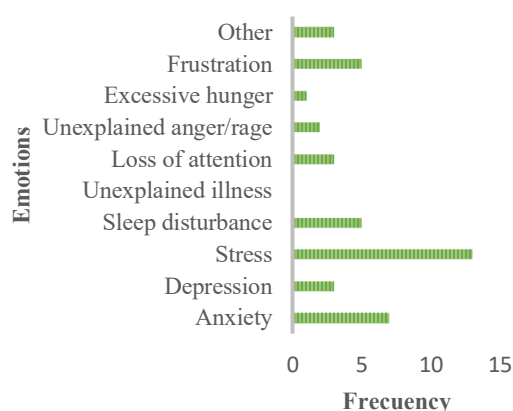
Box 8**Table 3**

Test statistic by groups

Test/question	How was your ability to cope in the work environment?	How would you rate your personal knowledge today?	How would you rate your knowledge in the company?
H de Kruskal-Wallis	3.411	3.138	5.174
G.L.	2	2	2
Sig. asintótica	0.182	0.208	0.075
a. a.	Kruskal Wallis test		
b. b.	Grouping variable:		
	race		

Source: Own elaboration

During your participation in the Dual Training Model, participants felt some negative emotions, which are summarised in the following graph.

Box 9**Figure 7**

Perception of emotions during participation

It has been observed that when students change context, leave university and face new challenges, they may experience both positive and negative emotions. Of those surveyed, 20.8% considered the possibility of dropping out of the Dual Training Model at some point, while 79.2% did not. Stress and anxiety are two of the most common emotions experienced.

As mentioned earlier, many participated in the Dual Training Model because of the advantages it offers, such as a job opportunity in the company with which they collaborate. At the end of their participation in the Dual Training Model, only 33.3% were hired by the company and 66.7% were not.

This is understandable, as many students participate in the dual programme while studying at the TSU level, then decide to return to their studies to continue their training. Most of the graduates hired were at the engineering level. Once they had completed the Dual Training Model, 100% of those surveyed would recommend the Model to their acquaintances.

This coincides with the overall satisfaction rate of over 80%. Everyone sees it as a good opportunity and experience, regardless of the technological area of their professional profile or the degree they have studied.

Conclusions

Participation in the Dual Training Model by students studying technology-related degrees at UTSEM, specifically Mechatronics, Food Processing and Information Technology, has been generally satisfactory. From 2019 to 2024, more than 50 students participated in this programme. The Information Technology degree programme has had the most students in the programme.

During their participation in the model, students complete their training in the areas of knowledge, know-how and, therefore, being, which gives them good opportunities in the workplace once they graduate, as a large percentage of them are hired by the company where they did their collaboration.

During their participation, they face situations that require them to adapt and be resilient, successfully completing their placement, which is reflected in the overall satisfaction index of their participation in the model, which has a medium to high impact.

The dual training model benefits not only the participating students, but also their mentors, as well as the company and the educational institution itself.

Therefore, it would be interesting to review how much the characteristics of the company and the role of the dual mentor influence the conclusion and satisfaction of the participant's stay in this model.

Appendices

The following is the survey form sent for this study

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Box 10

Table 1

Questionnaire for the analysis of the Dual Training Model at the Technological University of the South of the State of Mexico.

1. Year in which you participated in the Dual Training Model
2. Age [current age].
3. Gender.
4. Degree programme you studied at UTSEM
5. Overall grade point average upon graduation or current
6. Are you currently studying or working?
7. What were your reasons for joining the Dual Training Model?
8. How did you decide to participate in the Dual Training Model?
9. Did you receive financial support from the company or a scholarship during your participation in the Dual Training Model?
10. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how would you rate your time at the company where you were working as part of your participation in the Dual Training Model?
11. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how was your learning experience at the company?
12. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how would you rate your personal ability to function in the current work environment?
13. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how would you rate your knowledge training at the company?
14. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how would you rate your development during your time at the company while participating in the Dual Training Model?
15. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how would you rate your skills and know-how in relation to your professional profile?
16. On a scale of 1 to 5, with 1 being very poor and 5 being excellent, how would you rate your analytical skills?
17. Do you think your participation in the Dual Training Model improved any of your socio-emotional skills?
18. During your participation in the Dual Training Model, did you experience any of the following [select the most frequent]: anxiety, depression, stress, sleep disorder, illness without apparent reason, loss of attention, anger/rage without reason, excessive hunger, frustration, other.
19. During your participation in the Dual Training Model, did you ever consider dropping out? If yes, why?
20. Did the company where you participated in the Dual Training Model hire you at the end of the year?
21. Would you recommend to your friends who are studying for a university degree that they take part in the Dual Training Model?

Declarations

Conflict of interest

The authors declare that they have no conflicts of interest. They have no financial interests in conflict or known personal relationships that could have influenced the article presented in this work.

Contribution of authors

Hernández-Domínguez, María del Rosario: I contributed with the idea and development of the research.

Astivia-Arellano, Félix: I contributed to the review and editing.

Availability of data and materials

The data sets used or analysed during this study are available upon reasonable request from the corresponding author.

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Abbreviations

UTSEM	Technological University of the Southern State of Mexico
TSU	University Senior Technician
CGUT	Coordination of Technological Universities
SEP	Ministry of Public Education
UN	United Nations Organisation
G.L	Degrees of Freedom, <i>in a statistical study</i>

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Background

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