









Electromobility: a new approach to Higher Education

Electromovilidad: un nuevo enfoque para la Educación Superior

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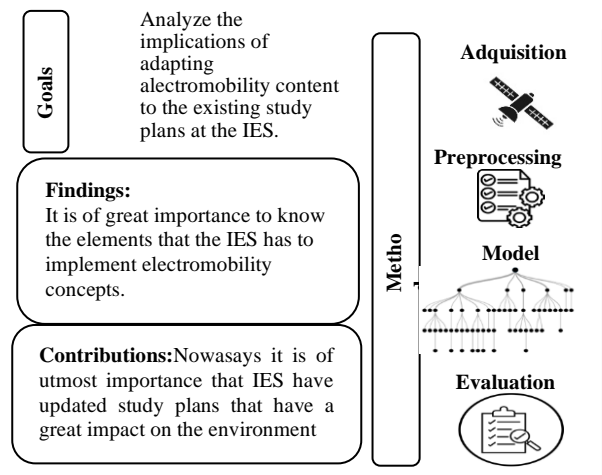
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Abstract

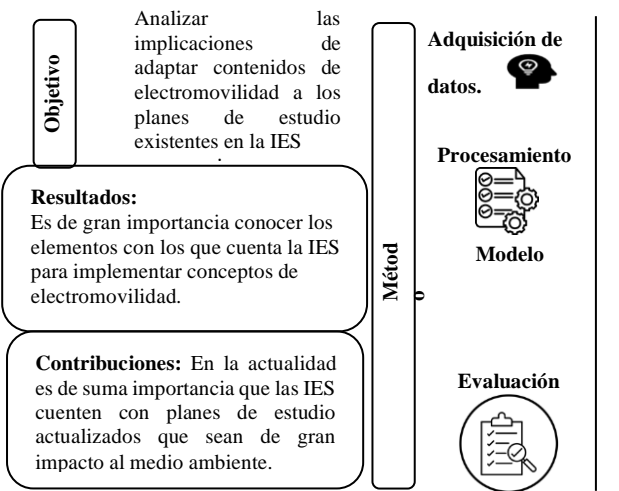
One of the areas where great changes are being generated is in the area of electromobility, vehicles whose energy base is electrical energy, where improvements are sought in the production processes, maintenance and acquisition capacity by users; However, it represents a point of innovation in Higher Education schools, where the importance of generating content aimed at this great branch that covers different aspects in the engineering part is revealed, given the importance in the sustainability part that It also represents a great advantage and a great impact in today's world.



Yield estimation, sugarcane, random forest regressor

Resumen

Una de las áreas donde se está generando grandes cambios, es en el área de electromovilidad, vehículos cuya base de energía es la energía eléctrica, donde se busca mejoras en los procesos de producción, mantenimiento y capacidad de adquisición por parte de los usuarios; sin embargo, representa un punto de innovación en las escuelas de Educación Superior, donde se pone de manifiesto la importancia de generar contenidos dirigidos a esta gran rama que abarca diferentes aristas en la parte de las ingenierías, dado la importancia en la parte de sustentabilidad que también representa una gran ventaja y un gran impacto en el mundo actual.



Estimación de la producción, caña de azúcar, random forest regressor

**Area:** Development of strategic leading-edge technologies and open innovation for social transformation

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## Introduction

One of the trends in today's world is the use of clean technologies that contribute to improving the environment and allow us to maintain the avant-garde use of technology; one of the areas where great changes are taking place is in the automotive area, without a doubt, Industry 4.0 has been reinforced with this new topic that is of great interest to provide solutions to problems that can be solved in the classroom. The term Electromobility refers to vehicles whose energy source is electricity, these models are considered as a transitional element towards new ways of moving without the need to use fuels that destroy and affect the environment.

In Higher Education Schools, the adaptation of new curricula related to some of the pillars contained in this new trend has been carried out, being the IOT and Artificial Intelligence, which have shown great relevance and interest for students, however, now a new topic appears: ELECTROMOBILITY, which is contributing to students to obtain new tools that allow them to integrate to the requirements of the use of motor vehicle production that, at present, represent a sustainable trend and that is increased day by day by the acquisition of this type of transport that includes cars, bicycles, scooters, buses, trains and cargo trucks, reducing the emission of pollutants and the emission of gases that give rise to the so dreaded greenhouse effect.

This work allows to show what are the implications of adapting new contents to the study plans within the IES focused on the management, development and application of processes that allow to enable the Electromobility, the fact that the students know and manage this type of subjects, will increase greatly their contribution to the companies that go to the vanguard in this field.

## Electromobility

Electromobility refers to the use of drive or traction systems using electric power applied to different means of transport [Electromobility Platform, 2024]. In the midst of the 4th Industrial Revolution, every day we realise that not having access to technological advances makes us incapable of living in this world; such is the impact of this issue that Higher Education Schools are already looking for ways to include content related to this area of engineering, and this is where the question arises:

Are HEIs really prepared with laboratories, infrastructure, teacher training, etc., to be able to carry out quality work in this area?

The answer can be varied, much depends on the resources available to each school, however, it should be focused on the fact that it is a resource of recent appearance, so there is not much industrial development in our country and it is doubtful the fact that they can properly take advantage of the curricula coupled to the educational institutions, especially by the fact that it is necessary a whole reengineering in the subjects that can be taught focused on the part dedicated to practices, the development of software and hardware architecture, etc. [Pinterest, 2024]

### Box 1



**Figure 1**

Electromobility

Source: [Pinterest, 2024]

However, it should be taken as a starting point that Electromobility in HEIs is extremely important, as it represents the change of focus to more sustainable communities and to have better trained graduates to face challenges related to the environment and technologically supported with the best tools focused on a better outlook as a nation. Some key points to consider are:

- A) **Broadening environmental awareness.** If young people about to enter the workforce create environmental awareness, this is guaranteed to have implications for the organisations in which they are employed.

## Box 2



Figure 2

Environmental awareness

*Source: (Pinterest, 2024)*

- B) **Direct linkages with national and international industrial sectors.** As this is a very recent sector, there is a wide range of employment opportunities where recent graduates will directly benefit from the wide range of options where they can put their acquired knowledge and skills into practice, both in the national and international markets. [Pinterest, 2024]

## Box 3



Figure 3

Linking with industry

*Source: (Pinterest, 2024)*

- C) **Innovation projects.** A budding area has the advantage that it can be developed extensively, generating research and innovation projects that promote a valuable impact for the society in which they are immersed, and teachers and students will play a very important role in this. [Pinterest, 2024]

## Box 4



Figure 4

Metaverse

*Source: (Pinterest, 2024)*

- D) **Fulfil as a society the objectives of sustainable development.** At present, the use of material resources is becoming increasingly difficult to afford, the creation of new ways of using fewer resources with different processes will allow us to have a better quality of life in the medium term. [Pinterest, 2024]

## Box 5



Figure 5

Sustainability

*Source: (Pinterest, 2024)*

- E) **Generation of laboratories and small companies focused on Electromobility issues.** New technologies, machinery and processes for resolving situations that require answers will undoubtedly benefit from the implementation of infrastructure focused on issues that can even generate new service stations, which will help to promote employment in this sector which, as mentioned above, can be a spearhead for improving and benefiting the economy. [Pinterest, 2024]



## Box 6



Figure 6

Sustainable stations

Source: (Pinterest, 2024)

### Implications of including Electromobility in the curricula of HEIs

The inclusion of this new Engineering, of recent appearance, will have several factors to take into account in its inclusion within the curricula such as:

1] Academic field: The curricular renewal allows the creation of programmes focused on smart grids, renewable energies, charging infrastructure and applications, and obviously electric vehicles, fostering knowledge and specialisation in environmental sciences, mechanics, electronics, telecommunications and technology in general; with this, various disciplines are also improved, allowing learning based on competences from different branches that will strengthen the teaching-learning processes such as cooperative work, management of hardware and software projects and sustainability.

2] Economic Scope: If HEIs promote graduates focused on the field of electromobility, it would attract companies focused on this branch of industry that develop technology and that would benefit from students who have the knowledge to be applied in the manufacturing, automotive and clean energy industries.

1] 3] Social Sphere. Students will learn about the consequences of focusing on solutions to reduce emissions and thus care for the environment, including generating sustainable practices for the communities in which they are located, including the use of clean technologies, the construction of low-cost electric transport and more efficient charging stations. [Pinterest, 2024]

### Can an Educational Institution [HEI] adapt curricula oriented towards Electromobility?

Electromobility refers to the use of electric vehicles and/or vehicles that use alternative energy, as this reduces emissions, noise, among others.

Thus, institutions are looking towards this horizon because it will bring great global benefits, but for this it is necessary to analyse the elements that higher education institutions [HEI] have in order to implement new content to educational plans; among the important elements to consider are: if they have teaching staff trained in this area of knowledge, as well as materials or laboratories that can adapt to this need, and finally if there are student candidates interested in this area.

### Methodology

In order to be able to carry out the study that is the objective of this field research, which is to review the implications of adapting new content to the curricula within the HEI to enable electromobility, this study will analyse the elements that HEIs have to adapt new content in the curricula. For this purpose, a survey was carried out firstly to the teachers who teach in the educational institution, and then another survey was carried out to the students who are studying the first semesters of the careers that are more oriented to electromobility concepts, which are: Engineering in Tics and Engineering in Mechatronics.

Fifteen teachers who teach in the Tics degree course and 20 teachers who teach in the mechatronics degree course were selected, taking an average sample of the most specialised teachers according to their profile.

The aim of the survey was to analyse how feasible it would be to propose new content for the electromobility curriculum at the HEI, taking into account the human and technological resources it currently has, obviously so that in the future it will benefit the companies in the surrounding area and the environment, with the reduction of pollutants, which is already part of the near future.

The survey was composed of seven questions, where the first part is to identify the total number of teachers belonging to the technological and mechatronics areas, with 43% being technologists and 57% mechatronics, as well as the profile of the subjects they teach, where 71% are from the technological area while 29% are electronics; On the other hand, we asked whether they have carried out research applied to the field of electromobility, obtaining 85% of teachers who have not carried it out, while familiarity with the concepts of electromobility is not at all strange since, 42% have read them or are somehow familiar with the terms of electromobility, which they consider important to be able to implement a career of this type in the not too distant future, as they will relate issues of sustainable development, Iot, technologies and everything that helps to reduce the high pollutants, being the great future that the environment wants to have for a better quality of life. [Escamilla, 2024]

It is of great importance not to leave aside that currently HEIs do not have trained practice laboratories or the necessary tools to be able to implement practices as close to reality, but in some way they can be supported by technologies such as simulation software that allows to carry out the necessary practices to get closer to reality, as well as to generate prototypes that allow students to obtain the necessary knowledge to carry out the electromobility curricula. The survey questions are listed below

Box 7

Table 1

Table of survey applied to specialised teachers

Carrera que imparte clases	ITICS	ISC
	15	20
Tipos de materia que imparte	Electronica	Tecnologica
	10	25
Has realizado investigación aplicada al campo de electromovilidad	SI	NO
	5	30
Esta familiarizado con el concepto electromovilidad	SI	NO
	15	20
Consideras importante la carrera orientada a electromovilidad	SI	NO
	24	11
Consideras que la IES cuenta con lo basico para implementar como plan de estudio la carrera de electromovilidad	SI	NO
	10	25
De acuerdo a su expertis los laboratorios con los que cuenta la IES pudieran servir de apoyo para un plan educativo de electromovilidad en que porcentaje	0-50%	60-100%
	27	8

Source: (Escamilla, 2024)

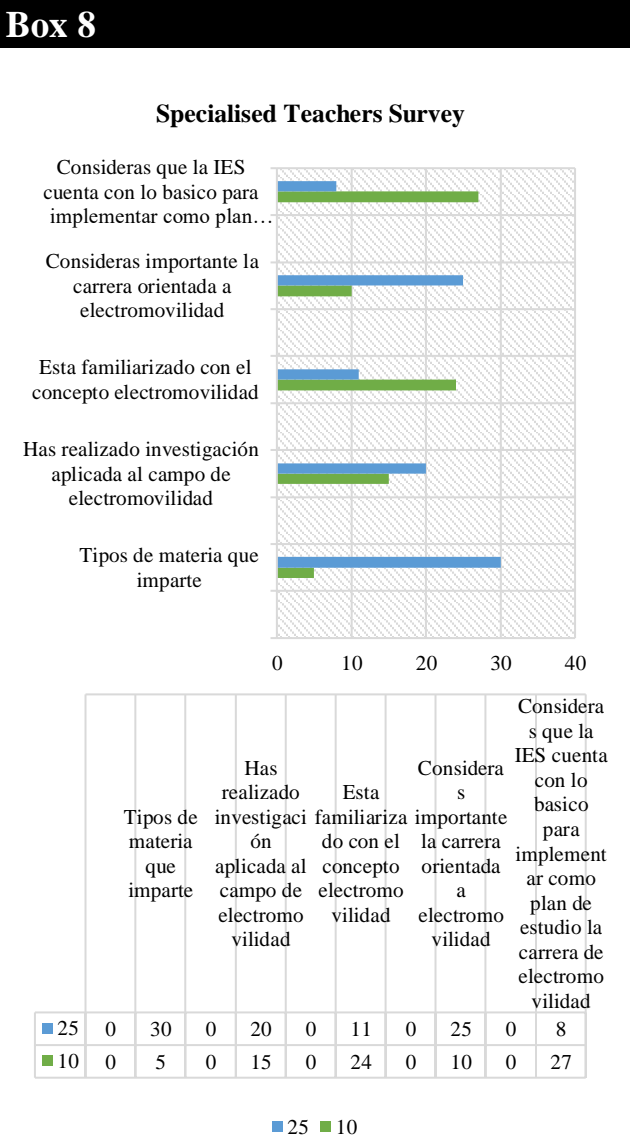


Figure 8

Graph of survey applied to specialised teachers.

Source: (Escamilla, 2024)

Once the analysis obtained from the results of the teachers' survey had been analysed, a survey was now applied to the students, which complements the initial objective since it will be possible to determine the knowledge or interest that the students have in this area; for this purpose, a representative sample was taken from both degree courses mentioned above, 80 students from the technological area and 120 students from the mechatronics area.

The survey has a total of seven questions, which can be seen in the following table and graphs. 35% of the students are in initial semesters and the remaining in advanced semesters, which allows them to already have a greater overview of the impact of introducing new topics to their curricula, with 65% of them knowing or at least having heard of the concepts of electromobility, which is the main reason why they have a greater understanding of the concepts of electromobility.

This gives a guideline that identifies if it would be beneficial to add this type of area to their study plans, with 70% of students who would accept that it would be implemented in their career as they mention that it benefits and broadens their current outlook once they graduate from the HEI, as well as focusing on the fact that the laboratories that the HEI has are not entirely good for them to be able to carry out practices in this area. [Escamilla, 2024]

Box 9

Table 2

Student survey table		
1.Carrera que esta estudiando	ITICS	Mecatronica
	80	120
2.Rango de semestre que cursas actualmente	1-4 semestre	5- 8 semestre
	70	130
3.Conoces de termino de electromovilidad	SI	NO
	130	70
4.Esta familiarizado con los conceptos de energia renovable, electromovilidad,	SI	NO
	125	65
5.Consideras que el uso de estas tecnologias impactara en tu carrera	SI	NO
	140	60
6.Consideras que los laboratorios de la IES pueden apoyar para implementar	SI	NO
	40	160
7.Te gustaria que tu plan de estudios se agreguen temas de esta area	SI	NO
	145	55

Source: (Escamilla, 2024)

Box 10

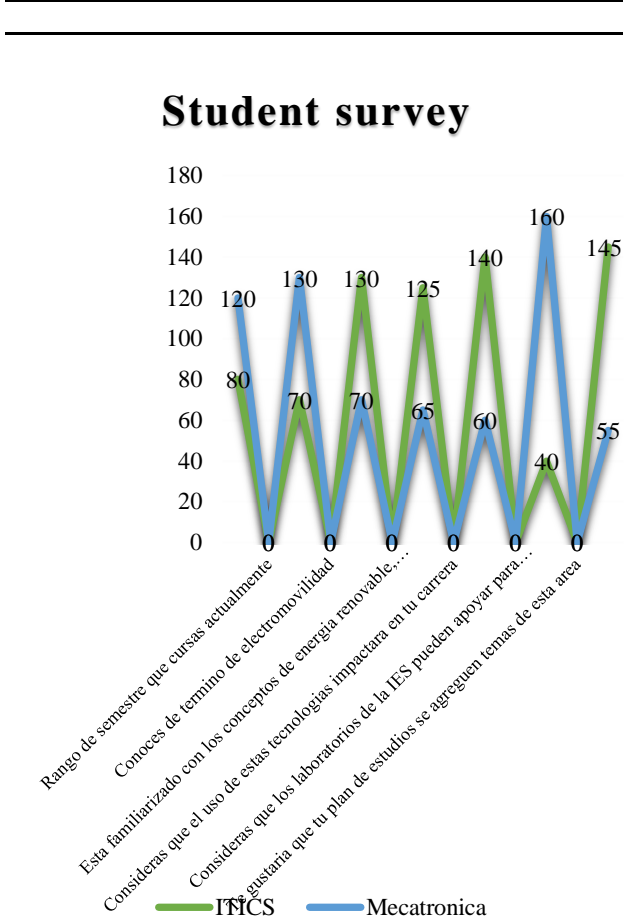


Figure 10

Student survey graph  
Source: (Escamilla, 2024)

The above shows that both teachers and students are not totally unaware of the concepts of electromobility and that they would agree to add these concepts to their current plans as part of a proposal, as they mention that they are part of a reality that is beginning to be experienced and that they consider that very soon they will have to implement them as project proposals, as companies will gradually require these concepts for their new proposals and that at last the HEI must be aware of updating itself so that its graduates are not left out of such hard-fought labour proposals that will come.

Results

The research carried out and analysed on the basis of the surveys that were applied to teachers and students, shows that we are increasingly in a very competitive environment, so it is of great importance to update the curricula that are currently in place, as in this case the proposal to add new topics or concepts of electromobility to the existing curricula that go according to the profile; but is it possible, what does the HEI have to achieve this? This is where the study tool comes in, which showed that the HEI has the necessary human resources to be able to implement new topics in the study plans, since 60% of the teachers know about the topics, although they have not applied them in research, they are no strangers to it, which helps a lot in the future if they wish to update the plans, and also, 50% of the students know about the topic, which is attractive to them, since they recognise that the better trained they graduate from the institution, the better job offers they can have, as well as being more competitive in a working environment.

Taking into account the aforementioned aspects, it is only agreed that the laboratories that the HEIs currently have are not entirely suitable for carrying out practices that contribute to the application of electromobility issues, but this would not be an impediment since the teachers mention that various simulation softwares can initially be used to support them in order to put theoretical knowledge into practice.

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## Conclusions

The study carried out has great contribution since the IES are the first in wanting to update their study plans to be at the forefront and cover with what is requested in the business environment, therefore, does not neglect to continue supporting the updates of teachers that allow to translate their knowledge and experience to the student body, It also encourages the development in the area of research by obtaining projects with funding and that these are oriented to the electromobility proposal. On the other hand, this study concludes with the great contribution that both teachers and students can make to add new topics of great impact to their existing study plans and that with this the graduates have more elements or tools for their great professional development.

## Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

## Area of study

The study is applied in the same HEI, since the sample of teachers and students was taken from there to collect the data that were analysed, which will be used to develop the proposal in the curricula in the future.

## Authors' contributions

The contribution of each researcher in each of the points developed in this research was defined as follows.

*Martinez-Bahena, Elizabeth:* Contributed to the main idea of the Project the bases on which they were implemented, with the state of the art, theoretical framework, type of research, approach and contribution to the writing of the article.

*Escamilla-Regis, Daisy:* Contributed to the type and design of the field research, the instrument, data collection and results, as well as to the writing of the article.

## Availability of data and materials

The images were obtained from the free Pinterest platform and the tables and graphs are self-authored with data obtained by applying the instrument within the institution.

## Funding

This work was funded by Tecnológico de Estudios Superiores de Cuautitlán Izcalli

## Abbreviations

IES	Higher Education Institutions
IoT	Internet of Things

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### Basic

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