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Journal of Information Technologies and Communications

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Support the international scientific community in its written production Science, Technology and Innovation in the Field of Engineering and Technology, in Subdisciplines of Multimedia information, networks, terminals, technological services, interactivity and interconnection, e-administration, video games, e-government, immateriality, digitization and innovation, image and sound quality parameters.

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Presentation of content

In the first article we present, *Creation of environments and scenarios for learning based on internet habits: a theoretical approach for face-to-face, blended and distance education*, by TAMARIZ-FLORES, Edna Iliana, SIORDIA-MEDINA, Paul Rafael, URIBE-OLIVARES, Nadia Sarahi and GONZÁLEZ-BASILIO, Sofía de Jesús with secondment at the Universidad Autónoma de Nayarit, as a second article we present, *Didactic demonstration of 3gdl robot dynamics and partitioned control for trajectory tracking*, by RAMÍREZ-AGUIRRE, Miguel, ORTIZ-SIMÓN, José Luis, AGUILERA-HERNÁNDEZ, Martha and CRUZ-HERNÁNDEZ, Nicolás, with an appointment at Instituto Tecnológico de Nuevo Laredo, as a third article we present, *Educational evaluation of renewable energy projects based on RETScreen software*, by MENDOZA-GONZÁLEZ, Felipe, HERNANDEZ-ESCOBEDO, Quetzalcoatl, VARGAS, Alejandro and CÓRDOVA-ESCOBEDO, Jesús Fausto, with secondment at the Universidad Veracruzana, as fourth article we present, *LKTs as a means of learning English for specific purposes in a virtual modality*, by FLORES-GONZÁLEZ, Norma, with secondment Benemérita Universidad Autónoma de Puebla.

Content

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Creation of environments and scenarios for learning based on internet habits: a theoretical approach for face-to-face, blended and distance education

Creación de ambientes y escenarios para el aprendizaje a partir de los hábitos en internet: un enfoque teórico para la educación presencial, semipresencial y a distancia

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Abstract

The creation of virtual learning environments requires extensive pedagogical, methodological and technical knowledge that generates relevant training processes and contributes to the development of student learning. That is why this article presents a proposal for a theoretical framework from which environments and scenarios can be designed and developed based on the Internet habits of students and teachers. Various theoretical and author proposals are integrated that allow understanding the complexity of this great task not only for those who work in the non-school modality, but now for those who have had to make the transition from face-to-face to virtual, which has meant significant changes in their teaching practice, but not only for them, but the students have acquired new habits or reinforced those they already had in order to face the new challenges posed by changes in reality.

Environments, Scenarios, Internet habits

Resumen

La creación de ambientes virtuales de aprendizaje requiere de amplios conocimientos pedagógicos, metodológicos y técnicos, que permitan generar procesos formativos pertinentes y que contribuyan al desarrollo de los aprendizajes de las y los estudiantes. Es por ello que en este artículo se presenta una propuesta de marco teórico desde el cual se pueden diseñar y desarrollar estos ambientes y escenarios a partir de los hábitos en internet de estudiantes y docentes. Se integran diversas propuestas teóricas y de autores que permiten comprender la complejidad de esta gran tarea no solo para quienes trabajan en la modalidad no escolar, sino ahora para quienes han tenido que realizar la transición de lo presencial a lo virtual, lo que les ha supuesto cambios significativos en su práctica docente, pero no solo para ellos, sino que los estudiantes han adquirido nuevos hábitos o reforzados los que ya tenían con la finalidad de hacer frente a los nuevos retos plateados por cambios de la realidad.

Ambientes, Escenarios, Hábitos en internet

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Introduction

The implementation of teaching and learning strategies is a constant and permanent exercise to allow students to acquire the expected knowledge or the knowledge established in a study program or learning unit, that is why the implementation, adaptation and updating of them strengthens the chances of this happening with less difficulty. It is here where we must pause a bit to be able to carry out an analysis about all the factors that have influenced our teaching in the educational modality in which we are immersed, whether it is face-to-face, blended or distance, this to try to identify what that has allowed the implemented strategies to have been relatively successful or totally successful, or on the contrary, to have failed. In this analysis it is very likely that we will find something related to the characterization of the student population, the use of some material for learning or technological resource, a permanent monitoring of the process, among other aspects that allow us to establish a base scheme to define a route of adequate work.

Taking as a reference what is stated in the previous paragraph, it is important to point out that one of the ways of incorporating computer technologies into a teaching-learning process can use the aforementioned route, where as a first step an analysis of the population is carried out with the which one is going to interact with, this in order to identify what its characteristics are and therefore its habits on the internet that allow defining an adequate way of working, while establishing permanent monitoring throughout the process to make the necessary modifications.

In this article a theoretical approach will be presented about how to create learning scenarios based on internet habits that can be implemented not only in distance mode, but also in face-to-face and blended learning, this in order to provide an orientation to those teachers who wish to strengthen their way of working with their school groups, as well as to those interested in this type of subject.

Permanent connection to the network

Everyday life allows us to witness that people are increasingly connected to the internet or using a social network platform. We can clearly show this situation when institutions and companies offer services through applications for cell phones or web pages, as well as information through platforms such as Facebook and WhatsApp that allow almost permanent communication with users, and permanent in some cases. Another much more common example is when we find Facebook accounts or YouTube channels where the users are people of the third and middle age.

In what is expressed in the study on the habits of Internet users in Mexico number 14 [I], it is announced that in 2017 it was recorded that there are 79.1 million Internet users in our country, which represents 66% of the population according to the data provided by the 2015 intercensal survey (EIC) carried out by the National Institute of Statistics and Geography (INEGI) [II].

Within the same study, it is revealed that the average time that users are connected to the internet is 8 hours 12 minutes (p.9). Which means that a third of the day is dedicated to being on the internet. This is an extremely important figure since if we start from a situation where we take as an example a person who sleeps between 6 and 8 hours on average, we have that half of the remaining 16 hours are used to carry out activities where they use the internet, which can be work, school or leisure. The study also reveals that 89% of Internet users prefer to navigate through the Smartphone (p. 11), and that 66% of them are of legal age, being the population between 18 and 44 years old the one that has the most presence when count on 50% (p.5).

With the data previously presented, what some older adults say is legitimized regarding the fact that people nowadays “spend it all day on their cell phones”, and in the same way, the importance of integrating this type of technological resources to the training of people within schools to make use of all that information with which they interact on a daily basis, and thereby enhance some of their skills towards the realization of a life project, the acquisition of new learning and reinforcement of those already obtained, and the diversification of educational scenarios.

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Therefore, it is necessary to identify through which device they access the Internet, what are their browsing habits, as well as their skills in terms of the management of ICTs to establish ad hoc activities and with greater possibilities of achieving learning with their incorporation.

Quality and quantity of information

The creation and dissemination of content on the internet is very common for those who access a platform for social networks, so it is not uncommon to find texts, images, videos and audios on almost any subject, thus allowing us to be informed in the format that best suits let's consider. Starting from this, it is important to analyze the quality and quantity of information with which we interact on a daily basis to identify those aspects that can become areas of opportunity for the creation of learning scenarios.

There is a very important point to highlight in this new paradigm of collaboration and learning with the support of the internet and new technologies, and that is related to the management of information, since it is very common to find erroneous data that are taken by people as something true by the mere fact of appearing on the internet, mainly on a social network.

An example of what is stated in the previous paragraph is the proliferation of satirical news portals such as El Deforma, El Ruinaversal or El Univerzarro, whose texts have been viralized mainly on Facebook, which are known as "Fake News". Below is an excerpt from a note from El Ruinaversal published on April 13, 2018, which is titled “EPN launches initiative to privatize water” [III]:

> Mexico DF. - A clandestine video was released where the president of the republic, Enrique Peña Nieto, declares in front of various public servants his plan to “privatize water”, supposedly in order to help Mexicans to have a better service and to save in its consumption.
> In the video the president explains that he is "fed up" of being the international mockery, since Mexico is recognized in other nations as "the country where you die if you drink tap water" and stressed that this is not a game since even in several chapters of "South Park" they have mocked this fact (Cortes, 2018, para. 1 and 2).

Examples such as the previous one allow us to highlight the importance of identifying the information that is being worked with in the teaching-learning processes, since sometimes we do not make sure if the sources are reliable, mainly in current affairs, a situation that is not exclusive of students, but also of the teachers in charge, which produces a misinformation that degenerates the learning sought. On the other hand, this type of situation can also be used in some disciplines as a didactic strategy for those subjects related to reading and writing, sociology or the media, to name just a few. Specifically, establishing an analysis of the information to know how it should or should not be integrated into the learning scenarios is something extremely important to achieve the proposed objectives, since it is useless to put it aside since it is It is scattered throughout the different social networks and collections consulted by all of us who inhabit the network.

Another aspect closely linked to the quality of the information is the quantity of it, a situation in which many of us contribute when interacting over the internet, given that the facility we have to generate content allows any user to share information in a specific space or platform. Which has generated that people become very popular thanks to the internet, such is the case of bloggers and youtubers, to mention the best known cases, which periodically generate information that is consumed by us users, however, on the other hand , there are also researchers or academics whose information is shared in spaces such as the Network of Scientific Journals of Latin America and the Caribbean, Spain and Portugal, better known as Redalyc, which facilitates the consultation of articles related to the social sciences, the Arts and Humanities.

Based on these examples, the fact of being able to access various information sources just by typing a word in any search engine is legitimized, which allows us to consult a considerable variety of information, which generates both favorable and unfavorable scenarios.

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Regarding the latter, Capurro (cited in Sebastié Salat, 2008) [IV] thinks that one of the problems of Information Ecology is "the overabundance and redundancy of information" (p.26), something that can complicate the search or analysis of it for those people who are immigrating to the internet or to the same users who have already been part of it for a long time, a situation that generates an area of opportunity from formal education or scenarios for learning to be created, given what to do Adequate or correct use of the spaces where we can consult such information gives us possibilities to diversify the strategies to acquire a particular learning.

For example, activities can be generated for users or students to analyze and discriminate information in relation to a topic, this in order that they can be classified for a more specialized query, a situation that can also be done from the teaching figure, where guidance is given in relation to which sources or collections are adequate to consult. Or in the best of cases, replicate something similar to Redalyc with the same or different format both inside and outside an institution.

Social networks and content generation

Social networks are popularly associated with platforms such as Facebook, YouTube, TikTok, and Instagram. However, its original concept is far from the use of technology by people. The concept of social network was introduced by John Arundel Barnes (cited in Requena Santos, 1989) [V], and he defines it as follows:

> "Each person is, as it were, in contact with a number of other people, some of whom are in contact with each other and some of whom are not. I think it convenient to call a social field of this type a network. The image I have is that of a network of points, some of which are connected by lines. The dots in this image will sometimes be people and other groups, and the lines would indicate who interacts with each other" (p. 143).

Based on the above, it is extremely important to find and analyze the possible connections between teachers and students in order to determine the points of convergence, and from there define activities aimed at the acquisition of one or more learning.

Therefore, the role of social media is crucial in reorienting educational practices within the classroom when seeking to create those connections.

This type of strategy, that of identifying common aspects between students and teachers to generate connections, works a lot in the classroom, since these aspects are a translator of ideas, as well as a constant and sometimes permanent communication bridge with groups of students. Students, these networks from personal experience, have been maintained to a large extent throughout a school year with the support of some platforms such as Facebook, which has allowed almost permanent communication with students through its function of groups and messaging, which have been of great help in the implementation of various activities. Among the activities carried out in these groups are those of sharing information or generating dynamics in order to obtain significant learning, which is defined by Ausbel (cited in Rodríguez Palmero, 2004) [VI] as:

> "The process according to which new knowledge or information is related to the cognitive structure of the learner in a non-arbitrary and substantive non-literal way. This interaction with the cognitive structure does not occur considering it as a whole, but with relevant aspects present in it, which are called subsumers or anchoring ideas" (p.2).

Therefore, the use of strategies that promote meaningful learning with the support of social networks and platforms contributes to the identification of convergences between teachers and students, which makes them an ideal tool to be in constant interaction in the learning process. teaching learning.

According to the 14 Study on the habits of Internet users in Mexico carried out by the Internet Mx Association in 2018 (previously mentioned), the use of platforms for social networks is the main activity that Mexicans carry out when we access Internet, the most used being Facebook, WhatsApp and YouTube. They have the characteristic that they can not only be used to consult information or communicate with different people, but also allow their users to generate and share content in different formats that can become known internationally and worldwide, mainly on Facebook and YouTube.

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In Latin American jargon, certain contents that are very popular nationally and internationally have been named "viral" or "viral", among which we find videos, images and audios, which in some cases the author is unknown or author. Many of these contents, apart from being called viral, are also known as “memes”, mainly images, and are an important part of current communication between people who inhabit the network.

The generation of content in social networks is not limited to the creation of memes, but also to the grouping of people in relation to a particular topic in forums and Facebook groups, which allow that regardless of the geography where they are located, they can participate in them.

Jenkins (2008) [VII] tells us about how “the collective creation of meanings within popular culture is beginning to change the modes of operation of religion, education, law, politics, advertising and the military world ”(P. 15).

And the generation of content on the internet in a collaborative way is a clear example of this because they have established a new dynamic of interaction between citizens, mainly with young people and adolescents, that is why currently it is not strange to see how they are a key factor for political campaigns or social events. A clear example of this within the political sphere in Mexico is what was done by Pedro Kumamoto, who was a deputy in the Jalisco congress, who with the use of social media platforms managed to gain supporters that allowed him to be elected in 2015, a situation that the Spanish newspaper El País relates as follows:

> “In every room in the tent there are young people working on laptops. This is how the entire campaign has been: sending WhatsApp messages, responding to tweets, mobilizing the candidate's proposals and videos on Facebook ”. "We also use Google tools, which are very good, to coordinate volunteers" (El País, 2015) [VIII].

The skills that are used for the generation of content is something that should not be neglected, since from them activities can be carried out that allow innovating the way of working between students and teachers.

New ways of learning

> “Information technologies are at the base of the changes that have occurred for several decades in practically all forms of human learning. A new culture of learning appears increasingly distant from formal education systems, from early childhood education to higher education. Today there are new and unprecedented possibilities to approach information, search for it, organize it, contrast it, represent it, process it, elaborate it and transform it into knowledge; with new and powerful forms of dissemination, communication and collaboration, opening the way to the search for new approaches and pedagogical approaches” (Delgado, 2018) [IX].

Virtual learning

Vygotsky (1978) [X] affirms that “human learning presupposes a specific social nature and a process by which children access the intellectual life of those around them” (p. 11). These proposed principles can be identified in current learning dynamics, learning generated in virtual environments, where thanks to the interaction of users from all over the world on the network, large-scale collective constructions can be generated that show us a new way of disseminate and build knowledge that allows to rethink the concept of learning through the way in which it can be given.

Regarding the new forms of learning Siemens (2004) [XI] affirms in his work Connectivism: a learning theory for the digital age, that:

> Informal learning is a significant aspect of our learning experience. Formal education no longer constitutes the majority of our learning. Learning now occurs in a variety of ways - through community practice, personal networks, and through the performance of work tasks” (p. 2).

For their part, Jaussi and Luna (cited in Saso, Aguadé, Gallart and Carol, 2006) [XII] talk about how "learning communities are considered as an egalitarian educational response to achieve an information society for everyone" (p.73). Which are defined by Valls (cited in Saso, Aguadé, Gallart and Carol, 2006) as:

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> (…) A project for the social and cultural transformation of an educational center and its environment, to achieve an information society for all people, based on dialogic learning, through participatory education of the community that is specified in all its spaces including the classroom (p.8).

An example of this is Wikipedia, which calls itself "The Free Encyclopedia", in which we can find that in 2020 there are more than 50 million articles in 300 languages [XIII], which are collectively constructed among registered users in it, and bots (computer programs that perform a specific task on the internet) dedicated to permanently reviewing each of the articles. This project strengthens the collaboration networks created independently between people from all over the world for the generation of content, which is accessed by a larger number for consultation.

Connectivism

The dynamics generated in the network potentiate in a very important way what is established by connectivism, where "the feeding and maintenance of connections is necessary to facilitate continuous learning" (Siemens, 2004, p.6). Which is adjusted to the conditions and sometimes current learning needs of people, mainly that of professionals, where, unlike other times, an almost permanent training has to be maintained due to scientific and technological advances, which they are faster than 20 years ago.

Therefore, identifying the habits that people have on the Internet provides us with elements to define suitable scenarios where the acquisition of learning occurs continuously with the support of new technologies. Scenarios where information is sought to flow permanently in a multidirectional way with the support of all those involved in the learning process.

Virtual environments for learning

The ways in which it is sought that people learn, assimilate and build knowledge are very diverse. Learning environments are one of the proposals that seek the aforementioned, these are defined by García (cited in Paredes Daza and Sanabria Becerra, 2015) [XIV] as:

> A system made up of a diverse set of related and organized elements that make it possible to generate stimulating circumstances for learning. They are based on the planning, design and arrangement of all the elements that promote it and correspond to the context in which the child develops, and to their learning process (p. 151).

Its implementation in learning processes must be precisely focused on stimulating learners, which can occur not only with ad hoc physical spaces, as it was manifested in its beginnings, but also in the use of strategies that allow those involved to generate connections to feel part of a group, as well as excited to acquire more information regarding the knowledge addressed. In this sense, the role of the teacher is essential to generate these connections, since they act as a guide and facilitator.

The strengthening of learning environments currently occurs with the integration of new communication-oriented technologies, since thanks to them it is possible to make use of tools that allow strengthening the knowledge acquired by both students and teachers through videos, images , audios, conversations in real time and asynchronously, to name just a few. This integration has allowed the generation of so-called virtual learning environments, which are defined by López Rayón, Escalera, and Ledesma (cited in Martínez de la Cruz et al, 2013) [XV] as:

> "The set of interaction environments, synchronous and asynchronous, where, based on a curricular program, the teaching-learning process is carried out, through a learning management system" (p.3).

This definition reveals that the key element of virtual environments is the same as traditional environments, that of interaction. Therefore, the activities to be carried out in a curricular space must be permanently focused on ensuring that students constantly interact with each other or with the expected learning through the use of software or applications, as well as practical situations.

Scenarios for learning

The ease with which people assimilate information about something has a lot to do with the interest of each one of us, since it allows us to carry out the necessary searches to understand everything related to it.

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The information on the network generates inquiries at various times and periods, which means that we know an event in detail in less than a day. Although, what has been described above does not assure us of learning, if it allows us to identify those tools that can serve us in the future to search for information about another subject, an essential element to take into account when building a learning scenario is involved, and It is because we can take advantage of these search or information management skills to guide certain activities aimed at achieving expected learning.

In this section we will understand learning scenarios as "a set of activities, resources and methods that reflects a learning unit or lesson" (Burgos and Corbalan, 2006, para. 2) [XVI]. Therefore, for its construction it is important to define the activities that allow it to be generated based on the interests of the students, who guide the construction or selection of resources and materials for learning, this without neglecting what is established in the program of studies, which is a guide to the minimum learning that students must acquire.

Based on the above, in the construction of the learning scenarios it is essential to incorporate aspects of the informal environment in formal settings, situations that the student or apprentice performs with great interest in their daily life, and not because it is intended that in the formal study is going to replicate this activity, but with the purpose of identifying how these activities can be used to link them with the knowledge addressed within the curricular space, allowing the generation of learning experiences in which students use everything they know or know to tackle new situations.

Collaborative work can strengthen the generation of these scenarios by allowing students to interact with each other freely to work on a concern or situation. In relation to this, the teacher or facilitator has the task of guiding the "scenarios with flexible curricular and didactic proposals, stimulating inquiry and autonomy" (Salinas, De Benito and Lizana, 2014, p.151) [XVII].

In this sense, the construction of scenarios for learning in virtual environments can use elements proposed in the instructional design, which will allow a structure to be based on. Next, the ASSURE model is detailed, where the characteristics that contribute to the generation of the scenarios are highlighted.

For Heinich (cited in Benítez Lima, 2010) [XVIII]: the ASSURE model is oriented to the classroom and is based on the approach of Robert Gagné (1985); It has its theoretical roots in behaviorism due to the emphasis on the achievement of learning objectives, however, constructivist traits are identified by worrying about the active and committed participation of the student (p. 7).

The ASSURE model consists of six procedures:

– The analysis procedure consists of identifying the socioeconomic and cultural aspects, learning styles, school trajectory and the expectations of the students, just to mention some elements that influence the behavior of the students (Benítez Lima, 2010).

– After carrying out the analysis of the student population, it is necessary to establish learning objectives so that students have knowledge of the learning that they will be able to acquire in a moment (Benítez Lima, 2010).

– The selection of strategies, technologies, means and materials allows teachers to decide which tools are to be used within the course to achieve the expected learning (Benítez Lima, 2010).

– Organizing the learning scenarios implies defining the activities that will be carried out during all the sessions, which are aimed at enabling students to acquire the expected learning (Benítez Lima, 2010).

– The participation of students is a very important element for the model, since it is sought that they interact constantly so that they exchange information in an almost permanent way, which contributes to the desired learning being less complicated to acquire (Benítez Lima, 2010).

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– Evaluation and review of the implementation and learning outcomes. In it, an assessment of the learning achieved by the students is carried out; the performance of the teacher and the total course is evaluated (Benítez Lima, 2010).

The procedures established in the previous model, mainly that of the analysis of the characteristics of the students, the organization of the scenarios for learning, and the participation of the students, will allow to guide the construction of the scenarios in an appropriate way by contemplating key elements such as student interests are.

Conclusion

The creation of environments and scenarios for learning contributes to redefining the way in which one works both in conventional and non-conventional modes of education, this by defining strategies that are built from the identification of Internet habits that students and students have. teachers, which is a success, since it starts from what they do on a daily basis on the internet, as well as from the way they access it, and not from a scheme alien to them that runs the risk of being rejected in their totality to be imposed. As a clear example of this that is mentioned, there are the multiple situations presented in the current pandemic generated by the coronavirus, where the rejection of the proposal of online and virtual classes is given by both teachers and students, since apart from the limited access or null to the Internet, the conditions of interaction between students and teachers were not taken into account, they were only “forced” to adopt a scheme that little by little has been fortunately assimilated and adapted to the conditions of each context, it is important clarify that it is understood that the Federal Government's proposal is perfectible, and that given the circumstances it is understandable that this was not fully accepted at first, what is rescued here is what was mentioned previously, which after a while , each institution and teachers, were adapting it according to their work characteristics and those of their group, something that comes to legitimize what is addressed in this document respect cto the creation of environments and scenarios for learning.

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Didactic demonstration of 3gdl robot dynamics and partitioned control for trajectory tracking

Demostración didáctica de la dinámica de robot de 3gdl y control particionado para seguimiento de trayectorias

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Abstract

The article presents the analysis of a robot with three degrees of freedom to follow trajectories through a partitioned control. Which is made up of two revolute and one prismatic joint where the end effector is located, that allows it to move correctly in its work area. This robot has a different structure from those most studied and analyzed by current literature, therefore it presents an opportunity to be used as a didactic resource, due to the structure, the degrees of freedom and the affinity of the models used by the students. The analysis consists of the use of the DH rule for the assignment of frames and referential axes, centers of mass, dynamic model by Jacobian and Christoffel symbols, inverse kinematic model, variables such as friction, gravitational and friction compensation, ending in a model in "Simulink" capable of following trajectories from the partitioned control law.

Computed partitioned control, Dynamic model of a robot, Path and trajectory planning

Resumen

Este artículo presenta el análisis de un robot de tres grados de libertad para el seguimiento de trayectorias a través de un control particionado. La estructura mecánica se compone de dos articulaciones de revolución y una prismática donde se encuentra el efector final que se desplaza en su espacio de trabajo. Este robot tiene una estructura diferente a las más estudiadas y analizadas por la literatura actual por lo que presenta una oportunidad para ser utilizado como recurso didáctico, debido a la estructura, los grados de libertad y la afinidad de los modelos que utilizaron los estudiantes. El análisis consta del uso de la regla DH para la asignación de marcos y ejes referenciales, centros de masa, modelo dinámico por Jacobianos y símbolos de Christoffel, modelo cinemático inverso, variables como fricción, compensación gravitatoria y de fricción, terminando en un modelo en Simulink de Matlab 2015 capaz de seguir trayectorias a partir de la ley de control particionado.

Control particionado, Modelo dinámico de un robot, Seguimiento de trayectorias

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Introduction

The contents of the subject of robotics at the engineering level, include the mathematical modeling systems of n degrees of freedom until reaching the issues of energy consumption in each actuator, in addition to the control methods for articular and Cartesian positioning, as well as the control for tracking of end effector trajectories.

Although the theoretical bases exist to carry out kinematic and dynamic analysis in a systematic way, most of the literature uses the same structures for its development, leaving gaps that can be explained in a simpler way by having other examples in terms of Structures refers, in addition to exposing the problems that can be faced at certain points in development.

In this document the mathematical models are developed to apply the calculated torque control for trajectory tracking in a different mechanical structure from the one that appears in the most used textbooks, which allows robotics students to clarify doubts that are not presented in the mechanical systems proposed in the texts and at the same time some of the most common mistakes made by students are exposed.

Structural design

A robot with three degrees of freedom is analyzed, made up of two revolution joints, followed by a prismatic joint (Fig. 1).

The structure is designed so that the end effector can move in the eight octants with mechanical limitations to exemplify a real scene.

The referential frames and axes were assigned, as well as their respective centers of mass according to the Denavit Hartemberg (DH) convention.

The centers of mass were determined according to the design of the robot in SolidWorks, to know its real position, although here they are shown in a generalized way.

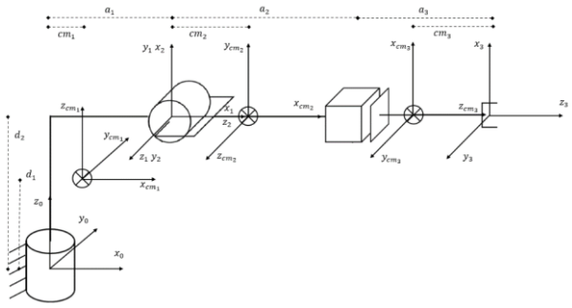

Figure 1 Assignment of frames, reference axes and centers of mass

Direct kinematics

According to the structure of Figure 1, the table of parameters of each link and center of mass that is observed in table 1 was obtained.

i	a_i	α_i	d_i	Θ_i
cm_1	cm_1	0	d_1	q_1
1	a_1	$\pi/2$	d_2	q_1
cm_2	cm_2	0	0	q_2
2	0	$\pi/2$	0	q_2
cm_3	0	0	$q_3 - cm_3$	0
3	0	0	q_3	0

Where:

i = Link
a_i = Link length
α_i = Link torsion
d_i = Link offset
Θ_i = Union variable

Each transformation matrix that describes the position and orientation of a frame i to i-1.
is obtained from:

$$ {}^{i-1}_{i}T = \begin{bmatrix} c_{\theta_i} & -s_{\theta_i}c_{\alpha_i} & s_{\alpha_i}s_{\alpha_i} & a_i c_{\theta_i} \\ s_{\theta_i} & c_{\theta_i}c_{\alpha_i} & -c_{\theta_i}s_{\alpha_i} & a_i s_{\theta_i} \\ 0 & s_{\alpha_i} & c_{\alpha_i} & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1) $$

Where $s_i = sin\, q_i$, $c_i = \cos q_i$ y $q_i = d_i$ for prismatic union and $q_i = \theta_i$ for revolutionary connections.

Using equation 1, the transformation matrices of for each link and center of mass are obtained, so that.

$$ {}^{0}_{cm_3}T = {}^{0}_{1}T\,{}^{1}_{2}T\,{}^{2}_{cm_3}T \quad (2) $$

having as general matrices the following.

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$$_{cm_3}^{0}T = \begin{bmatrix} c_1c_2 & s_1 & c_1s_2 & (q_3 - cm_3)c_1s_2 + a_1c_1 \\ s_1c_2 & -c_1 & s_1s_2 & (q_3 - cm_3)s_1s_2 + a_1s_1 \\ s_2 & 0 & -c_2 & -(q_3 - cm_3)c_2 + d_2 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (3)$$

Thus, obtaining the direct kinematic model of the robot.

$$r_{11} = c_1c_2$$
$$r_{21} = s_1c_2$$
$$r_{31} = s_2$$
$$r_{12} = s_1$$
$$r_{22} = -c_1$$
$$r_{32} = 0$$
$$r_{13} = c_1s_2$$
$$r_{23} = s_1s_2$$
$$r_{33} = -c_2$$
$$P_x = q_3c_1s_2 + a_1c_1$$
$$P_y = q_3s_1s_2 + a_1s_1$$
$$P_z = -q_3c_2 + d_2 \quad (4)$$

Where the elements r_{ij} describe the orientation of the referential frame cm_3 to the zero frame.

Dynamic model using Jacobian

Jacobians are calculated for each center of mass through the partial derivative of the joint position according to equation 5.

$$J_{v_{cm_i}} = \begin{bmatrix} \frac{d}{dq_1}\left(P_{x_{cm_i}}\right) & \frac{d}{dq_2}\left(P_{x_{cm_i}}\right) & \cdots \frac{d}{dq_n}\left(P_{x_{cm_i}}\right) \\ \frac{d}{dq_1}\left(P_{y_{cm_i}}\right) & \frac{d}{dq_2}\left(P_{y_{cm_i}}\right) & \cdots \frac{d}{dq_n}\left(P_{y_{cm_i}}\right) \\ \frac{d}{dq_1}\left(P_{z_{cm_i}}\right) & \frac{d}{dq_2}\left(P_{z_{cm_i}}\right) & \cdots \frac{d}{dq_n}\left(P_{z_{cm_i}}\right) \end{bmatrix} \quad (5)$$

$$J_{vcm_1} = \begin{bmatrix} -cm_1s_1 & 0 & 0 \\ cm_1c_1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \quad (6)$$

With equation 7 the angular velocity of the reference frame is calculated at the i-th center of mass

$$_{i}^{0}\omega = \rho_1 \cdot \overrightarrow{z_0 q_{(1)}^{\cdot}} \ldots + \rho_n \cdot {}_{i-1}^{0}R_{(t)}\overrightarrow{z_{\iota-1}} \text{-} q_{(\iota)}^{\cdot} \quad (7)$$

Where:

$$\rho = \begin{Bmatrix} 1\ for\ revolutionary\ union \\ 0\ \ for\ prismatic\ junction \end{Bmatrix}$$

Then in a generalized way for the n-th frame of reference equation 7 can be rewritten as

$$_{n}^{0}\omega = \begin{bmatrix} \rho_1\overrightarrow{z_0} & \rho_2 {}_{1}^{0}R_{(t)}\overrightarrow{z_1} & \cdots & \rho_n {}_{n-1}^{0}R_{(t)}\overrightarrow{z_{n-1}} \end{bmatrix} \begin{bmatrix} q_{(1)}^{\cdot} \\ q_{(2)}^{\cdot} \\ \vdots \\ q_{(n)}^{\cdot} \end{bmatrix} \quad (8)$$

Where:

$$J_{w_n} = \begin{bmatrix} \rho_1\overrightarrow{z_0} & \rho_2 {}_{1}^{0}R_{(t)}\overrightarrow{z_1} & \cdots & \rho_n {}_{n-1}^{0}R_{(t)}\overrightarrow{z_{n-1}} \end{bmatrix}$$

It is known as the Jacobian of angular velocity for a robot that has prismatic joints and that is revolutionary in its structure. Based on this we have to

$$J_{w_{cm1}} = \begin{bmatrix} \rho_1\overrightarrow{z_0} & 0 & 0 \end{bmatrix} \quad (9)$$

$$J_{w_{cm1}} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad (10)$$

And using equation 11 to obtain the Jacobian of center of mass one.

$$J = \frac{J_v}{J_\omega} \quad (11)$$

$$J_{cm1} = \begin{bmatrix} -cm_1s_1 & 0 & 0 \\ cm_1c_1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad (12)$$

In the same way, it is calculated for the center of mass two, the Jacobian of the center of mass two is calculated.

$$J_{cm2} = \begin{bmatrix} -cm_2s_1c_2 - a_1s_1 & -cm_2c_1s_2 & 0 \\ cm_2c_1c_2 + a_1c_1 & -cm_2s_1s_2 & 0 \\ 0 & cm_2c_2 & 0 \\ 0 & s_1 & 0 \\ 0 & -c_1 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad (13)$$

Also it is obtained

$$J_{cm3} = \begin{bmatrix} -(q_3 - cm_3)s_1s_2 - a_1s_1 & (q_3 - cm_3)c_1c_2 & c_1s_2 \\ (q_3 - cm_3)c_1s_2 + a_1c_1 & (q_3 - cm_2)s_1c_2 & s_1s_2 \\ 0 & (q_3 - cm_2)s_2 & -c_2 \\ 0 & s_1 & 0 \\ 0 & -c_1 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad (14)$$

For the calculation of the inertia matrix, equation 15 is used.

$$D = \sum_{i=1}^{3}\left(m_iJ_{v_{cm_i}}^{T}J_{v_{cm_i}} + J_{\omega_i}^{T}R_{i-0}^{0}I_iR_{i-0}^{0}{}^{T}J_{\omega_i}\right) \quad (15)$$

Where the inertia tensor I is given in a generalized way by:

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$$I_i = \begin{bmatrix} I_{xx_i} & I_{xy_i} & I_{xz_i} \\ I_{yx_i} & I_{yy_i} & I_{yz_i} \\ I_{zx_i} & I_{zy_i} & I_{zz_i} \end{bmatrix} \quad (16)$$

And for the presented simulation, the identity value is assigned to the inertia tensor.

$$D = \begin{bmatrix} D_{11} & D_{12} & D_{13} \\ D_{21} & D_{22} & D_{23} \\ D_{31} & D_{32} & D_{33} \end{bmatrix} \quad (17)$$

$$\begin{aligned} D_{11} &= I_{xx1} + m_3(a_1 - cm_3 s_2 + q_3 s_2)^2 + m_2(a_1 + cm_2 c_2)^2 + cm1^2 m_1 + c_1(I_{yyz}c_1 - I_{xyz}s_1) + I_{xxz}s_1^2 - I_{yyz}c_1 s_1 \\ D_{12} &= I_{xy2}s_1^3 + I_{yz2}c_1c_2 - I_{xz2}c_2s_1 + I_{xx2}c_1s_1^2 - I_{xy2}c_1^2s_1 - I_{yy2}c_1s_1^2 \\ D_{13} &= 0 \\ D_{21} &= I_{xy2}s_1^3 + I_{yz2}c_1c_2 - I_{xz2}c_2s_1 + I_{xx2}c_1s_1^2 - I_{xy2}c_1^2s_1 - I_{yy2}c_1s_1^2 \\ D_{22} &= cm_2^2m_2 + cm_3^2m_3 + m_3q_3^2 + I_{zzz}c_1^2 + I_{yyz}s_1^2 + I_{xxz}c_1^2s_1^2 - 2cm_3m_3q_3 + 2I_{xyz}c_1s_1^2 - 2I_{yyz}c_1s_1^2 - 2I_{xzz}c_1^2s_1 \\ D_{23} &= 0 \\ D_{31} &= 0 \\ D_{32} &= 0 \\ D_{33} &= m_3 \end{aligned} \quad (18)$$

To calculate the Coriolis matrix by this method the Christoffel symbols are used

$$\mathrm{c_{i,j,k}} = \frac{1}{2}\left\{\frac{\partial dkj}{\partial i} + \frac{\partial dki}{\partial j} - \frac{\partial ij}{\partial k}\right\} \quad (19)$$

Where the combinations of the symbols are as follows

$$\mathrm{C_{kj}} = \sum_{i=1}^{n}\left(\mathrm{c_{ijk}}\dot{\mathrm{q}}_\mathrm{i}\right) \quad (20)$$

$$C = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} \quad (21)$$

$$\begin{aligned} C_{11} &= m_3\dot{q}_3 s_2(a_1 - s_2(cm_3 - q_3)) - \dot{q}_2(m_3c_2(cm_3 - q_3)(a_1 - s_2(cm_3 - q_3)) + cm_2m_2s_2(a_1 + cm_2c_2)) \\ &\quad - \dot{q}_1(I_{xy2}c_{2q_1} - \frac{1}{2}I_{xx2}s_{2q_1} + \frac{1}{2}I_{yy}s_{2q_1}) \\ C_{12} &= \dot{q}_2\left(\frac{1}{4}I_{xz2}c_1 + \frac{1}{4}I_{yz2}s_1 - \frac{1}{2}I_{xy2}c_{2q_1} + \frac{1}{2}I_{xy2}c_{4q_1} + \frac{3}{4}I_{xz2}c_{3q_1} - \frac{1}{4}I_{xx2}s_{4q_1} - \frac{1}{2}I_{yy2}s_{2q_1} + \frac{1}{4}I_{yy2}s_{4q_1}\right. \\ &\quad \left. + \frac{3}{4}I_{yz2}s_{3q_1} + \frac{1}{2}I_{zz2}s_{2q_1}\right) - \dot{q}_1(m_3c_2(cm_3 - q_3)(a_1 - cm_3s_2 + q_3s_2) \\ &\quad + cm_2m_2s_2(a_1 + cm_2c_2)) \\ C_{31} &= m_3\dot{q}_1 s_2(a_1 - cm_3s_2 + q_3s_2) \\ C_{21} &= \dot{q}_1(5I_{xy2}(c_1 - c_1^3) + 2I_{xx2}(s_1 - s_1^3) - 2I_{yy2}(s_1 - s_1^3) - I_{xy2}c_1^3 - I_{xz2}c_1^2 - I_{yz2}s_{2q_1} - I_{xx2}s_1^3 + I_{xz2}s_1^2 \\ &\quad + I_{yy2}s_1^3 + m_3c_2(cm_3 - q_3)(a_1 - cm_3s_2 + q_3s_2) + cm_2m_2s_2(a_1 + cm_2c_2) \\ &\quad - \dot{q}_2\left(\frac{1}{4}I_{xz2}c_1 - \frac{1}{4}I_{yz2}s_1 - \frac{1}{2}I_{xy2}c_{2q_1} + \frac{1}{2}I_{xy2}c_{4q_1} + \frac{3}{4}I_{xz2}c_{3q_1} - \frac{1}{4}I_{xx2}s_{4q_1}\right. \\ &\quad \left. - \frac{1}{2}I_{yy2}s_{2q_1} + \frac{1}{4}I_{yy2}s_{4q_1} + \frac{3}{4}I_{yz2}s_{3q_1} + \frac{1}{2}I_{zz2}s_{2q_1}\right) \\ C_{22} &= \frac{1}{2}I_{xy2}\dot{q}_1c_{2q_1} - \frac{1}{2}I_{xy2}\dot{q}_1c_{4q_1} - \frac{3}{4}I_{xz2}\dot{q}_1c_{3q_1} + \frac{1}{4}I_{xx2}\dot{q}_1s_{4q_1} + \frac{1}{2}I_{yy2}\dot{q}_1s_{2q_1} - \frac{1}{4}I_{yy2}\dot{q}_1s_{4q_1} - \frac{3}{4}I_{yz2}\dot{q}_1s_{3q_1} \\ &\quad - \frac{1}{2}I_{zz2}\dot{q}_1s_{2q_1} - cm_3\dot{q}_3m_3 + m_3q_3\dot{q}_3 - \frac{1}{4}I_{xz2}\dot{q}_1c_1 + \frac{1}{4}I_{yz2}\dot{q}_1s_1 \\ C_{23} &= -m_3\dot{q}_2(cm_3 - q_3) \\ C_{31} &= -m_3\dot{q}_1s_2(a_1 - cm_3s_2 + q_3s_2) \\ C_{32} &= m_3\dot{q}_2(cm_3 - q_3) \\ C_{33} &= 0 \end{aligned} \quad (22)$$

Finally obtaining the gravity vector through the partial derivative of the potential energy.

$$g = \frac{\partial E_{P_T}}{\partial q_i} \quad (23)$$

$$g = \begin{bmatrix} 0 \\ -m_2cm_2c_2 - m_3q_3s_2 + m_3cm_3s_2 \\ m_3c_2 \end{bmatrix} g \quad (24)$$

Once the inertia matrix, Coriolis matrix and the gravity vector have been obtained, the dynamic model can be represented.

$$\tau = D(q)\ddot{q} + C_{(q,\dot{q})}\,\dot{q} + g(q) \quad (25)$$

Viscous friction

For the verification of this model through software, equation 26 was specifically arranged to enter the data in Matlab, the simulation will be part of the last section, but the following equations are used for the next section.

$$D_{(q)}\ddot{q} = \tau - C_{(q,\dot{q})}\,\dot{q} - g_{(q)} \quad (26)$$

In order to solve for q¨the entire equation was multiplied by the inverse of the matrix of D and thus became the identity.

$$D_{(q)}{}^{-1}D_{(q)}\ddot{q} = D_{(q)}{}^{-1}\left[\tau - C_{(q,\dot{q})}\,\dot{q} - g_{(q)}\right] \quad (27)$$

$$\ddot{q} = D_{(q)}{}^{-1}\left[\tau - C_{(q,\dot{q})}\,\dot{q} - g_{(q)}\right] \quad (28)$$

The effects of friction in mechanical systems are complicated phenomena that depend on multiple factors such as the nature of the materials in contact, their lubrication, temperature, etc. For this reason, friction forces and torques are roughly modeled.

For reasons of simplicity in the model, the friction matrix was assigned as identity.

$$\mathrm{F_r} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (29)$$

For this viscous friction was added to the dynamic model.

$$\tau = D_{(q)}\ddot{q} + C_{(q,\dot{q})}\,\dot{q} + F_r\dot{q} + g_{(q)} \quad (30)$$

```
for i=0:360
    for j=0:360
        for k=0:12
            q1= i;
            q2= j;
            q3= k;

            Pxd = q3*cosd(q1)*sind(q2)
                  +cosd(q1) -Px;
            Pyd = q3*sind(q1)*sind(q2)
                  +sind(q1) -Py;
            Pzd = -q3*cosd(q2)
                  +1 -Pz;

            if (abs(Pxd) < 0.01 & abs(Pyd)
            < 0.01 & abs(Pzd) < 0.01)

                Q = [q1; q2; q3;]
                break
            end

        end
        if (abs(Pxd) < 0.01 & abs(Pyd)
            < 0.01 & abs(Pzd) < 0.01)

            break
        end
    end
    if (abs(Pxd) < 0.01 & abs(Pyd)
        < 0.01 & abs(Pzd) < 0.01)
        break
    end
end
```

Table 1 Algoritmo para el MCI

$$D_{(q)}\ddot{q} = \tau - C_{(q,\dot{q})}\,\dot{q} - F_r\dot{q} - g_{(q)} \quad (31)$$

$$\ddot{q} = D_{(q)}{}^{-1}\left[\tau - C_{(q,\dot{q})}\,\dot{q} - F_r\dot{q} - g_{(q)}\right] \quad (32)$$

Gravitational and friction compensation

With a dynamic model that considers viscous friction in turn, a compensation for gravity and friction that occurs in a physical environment was added to make the robot's movements smoother and avoid the sudden fall of the second link due to gravity..

$$D_{(q)}\ddot{q} + C_{(q,\dot{q})}\,\dot{q} + F_r\dot{q} + g_{(q)} = \tau + \left(F_r\dot{q} + g_{(q)}\right) \quad (33)$$

Inverse kinematic model (MCI)

To control the robot, the desired Cartesian position is entered, where it passes through the inverse kinematics, resulting in the joint positions of the robot that enter the control that outputs the real joint positions, then these pass to the direct kinematic model with I know that it obtains the real Cartesian position and in parallel the movement of the robot is plotted until it reaches the positions.

To obtain the equations, the orientation and position are needed because by the configuration of the robot it can reach a point in space with different orientations, but for this point it only needed to place the end effector at the point in the specified space regardless of the orientation.

For this, a through a series of cycles was used, the different combinations were tested until finding the joint position that satisfied the position in the desired space and the sampling and execution times gave the results in less than two seconds.

Partitioned control for trajectory tracking

For this partitioned control, a proportional and derivative control was used in part where the gains of each one were multiplied by the error between the desired value and the real one. For this:

$$qd = qr \quad (34)$$

$$\Delta q = qd - q = 0 \quad (35)$$

Where $\dot{q}$ desired was intended to be zero

$$\Delta\dot{q} = \dot{q}d - \dot{q} = 0 => \dot{q}d = \dot{q} \quad (36)$$

$$\Delta\ddot{q} = \ddot{q}d - \ddot{q} = 0 \quad (37)$$

With this, open loop control was obtained

$$\ddot{q} = \hat{\tau} \quad (38)$$

Thus having the Law of control

$$\hat{\tau} = \ddot{q}d + Kv\Delta\dot{q} + Kp\,\Delta q \quad (39)$$

Once the equations were integrated as a closed loop, they were as follows.

$$\ddot{q} = \ddot{q}d + Kv\Delta\dot{q} + Kp\,\Delta q \quad (40)$$

$$0 = -\ddot{q} + \ddot{q}d + Kv\Delta\dot{q} + Kp\,\Delta q \quad (41)$$

$$0 = \Delta\ddot{q} + Kv\Delta\dot{q} + Kp\,\Delta q \quad (42)$$

With this, we had the partitioned control and proceeded to the assembly in Simulink to check the correct trajectory tracking.

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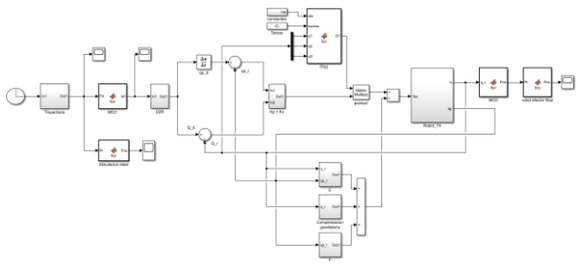

Figure 2 Simulation in Matlab Simulink

Figure 2 shows the simplified assembly of this control, which is made up of several subsystems and Figure 3 shows the robot modeling that can be replaced by a physical system.

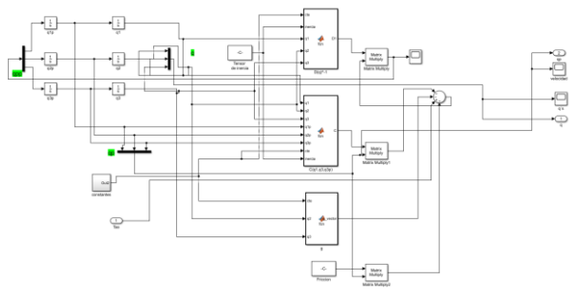

Figure 3 Physical robot model

In the first place, there is the trajectory generator that, for this control, was designed to make a circle in two dimensions, this is achieved through a cosine function on the 'x' axis, a constant on 'y' and a sine function on the 'z' axis. Once these points are obtained, they will be graphed in real time in the same Figure where the trajectory of the robot will be graphed.

Once the trajectory is generated, it goes to the inverse kinematic model where it must find the articular positions for each point of the trajectory. Because thanks to the configuration you can have several orientations for the same position and the MCI is only using the position, there can be multiple values for 'Q' that satisfy it.

Once the values for the articulation are obtained, it enters the partitioned control stage, after the control is passed to the direct kinematics that then graphs in the same Figure of the path that is desired for the comparison.

Results

Gain values in constant Kp and Kd were used for the simulation.

link	1	2	3
K_p	10	30	50
K_v	10	10	50

Table 2 Profits K_p y K_v

The dimensions of the links and relationships with the centers of mass were obtained through SolidWorks 2018.

$a_1 = 0.55\ m$
$g = 9.81\ m/s^2$
$\mathrm{m}_1 = 2.6\ \mathrm{Kg}$
$\mathrm{m}_2 = 2.7\ \mathrm{Kg}$
$\mathrm{m}_3 = 1\ \ \mathrm{Kg}$
$cm_1 = 0.3\ m$
$cm_2 = 0.3\ m$
$cm_3 = 0.3\ m$

For this simulation, the first and second joints were started at π / 2 and the third a meter.

$$P_2 = [0 \quad 3 \quad 2]^T \tag{43}$$

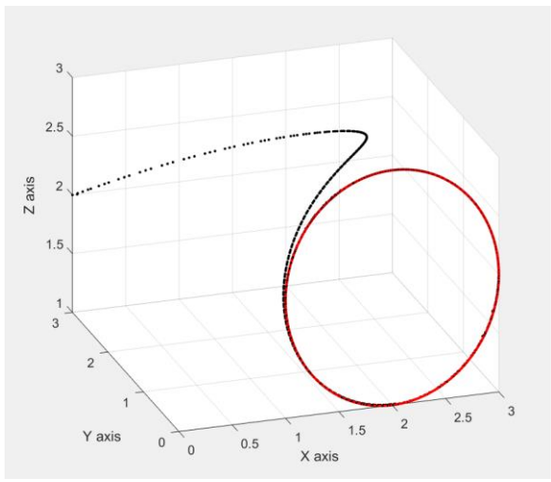

Figure 3 Trajectory

In Figure 4 you can see the desired trajectory in red and the trajectory made by the robot in black, it is appreciated where when starting its in different initial conditions it followed the trajectory until it reached it and aligned itself to the desired one.

Conclusion

As shown in Figure 3, even starting with different initial conditions, the control is able to align itself with the desired trajectory after 4 seconds of starting and once reached it is not lost. This demonstrates the efficacy of partitioned control for tracking trajectories, in this structure.

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This article has focused on the process and development of a partitioning control, taking into account factors such as friction, gravitational and friction compensation, constant Kp and Kd gains, as well as the direct and inverse kinematic model, for the purpose of didactic use or support for similar structures.

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Educational evaluation of renewable energy projects based on RETScreen software

Evaluación educativa de proyectos de energías renovables basados en el software RETScreen

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Abstract

In the design of renewable energy projects, a present problem is the techno-economic evaluation of them, regularly different methods and models are used to do it, in this work it is proposed to innovate in the degree of Engineering in Renewable Energies (LIER) of the UNAM in the National School of Superior Studies Juriquilla campus the way to evaluate projects using the software RETScreen. This paper presents a methodology to evaluate a wind energy project in the state of Queretaro Mexico. The project contemplates a wind turbine brand VESTAS V44 - 40m of 600 kW capacity of 40 m height in the state of Querétaro in the center of the country of Mexico. The initial costs of this wind turbine are 1,283 $/kW or 770,000 USD, with a rate of 80 $/kW. The electricity exported to the grid is 1,703 MWh and the income from electricity exports is 136,235.52 USD. With this wind turbine you can save 1,318.2 tCO_2 per year or 566,414 liters of unused gasoline.

Projects, Renewable energies, Education

Resumen

En el diseño de proyectos de energías renovables un problema presente es la evaluación tecno-económica de ellos, regularmente se utilizan diferentes métodos y modelos para hacerlo, en este trabajo se propone innovar en la licenciatura de Ingeniería en Energías Renovables (LIER) de la UNAM en la Escuela Nacional de Estudios Superiores campus Juriquilla la forma de evaluar proyectos utilizando el software RETScreen. En este trabajo se presenta una metodología para evaluar un proyecto de energía eólica en el estado de Querétaro México. El proyecto contempla un aerogenerador marca VESTAS V44 - 40m de 600 kW de capacidad de 40 m de altura en el estado de Querétaro en el centro del país de México. Los costos iniciales de este aerogenerador son de 1,283 $/kW o 770,000 USD, con una tarifa de 80 $/kW. La electricidad exportada a la red eléctrica es de 1,703 MWh y los ingresos por exportación de electricidad es de 136,235.52 USD. Con este aerogenerador se pueden ahorrar 1,318.2 tCO_2 al año o 566,414 litros de gasolina no utilizados.

Proyectos, Energías renovables, Educación

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Introduction

Renewable energy is the current trend of obtaining energy. Numerous scientists, inventors, and engineers are working to harness renewable energy. The application of renewable energy is very broad; It can be as small as the illumination of an LED bulb or as large as the electricity generation of a city or even a country. Wind energy plays an important role in the context of electricity generation, it depends both on the speed of the wind at a site and on the atmospheric conditions, its orography and roughness. It can only be considered as a wind resource until these variables have been considered. Its evaluation is necessary for the design and evaluation of wind sites that every professional in this area should consider. Renewable energy is the current trend of obtaining energy. Numerous scientists, inventors, and engineers are working to harness renewable energy. The trend of the application of renewable energy is due to the saturation of carbon dioxide in the atmosphere as described (Li et al., 2020). Although carbon dioxide could be absorbed by plants during the day through photosynthesis, excessive carbon dioxide emission and illegal deforestation contributed to global warming (Sikarwar et al., 2020). The effects of global warming have recently been seen and found by humanity. Rising sea water could sink some islands and countries in the coming decades.

The application of renewable energy is very broad; It can be as small as the illumination of an LED bulb or as large as the electricity generation of a city or even a country. Wind energy plays an important role in the context of electricity generation (Wang et al., 2020). Wind power is highly dependent on the speed of the wind at a wind site. Wind prediction is necessary for an assessment of the wind energy of a potential wind farm (Adetokun et al., 2020). The exploitation of wind energy for power generation is taking an important role in the consumption of electricity worldwide. Proper use of the wind resource could maximize its capacity factor and minimize electricity costs (Alkhalidi et al., 2020). The global wind power production capacity has doubled about three times, from 147 GW at the end of 2008 to 435 GW at the end of 2015.

It has been deployed by many countries such as the United States, Germany, Spain, China, India, the United Kingdom and Egypt. China is considered to be the dominant country in this field where its installed capacity is 145 GW, followed by the United States with 73 GW, Germany 45 GW, India 25 GW, Spain 23 GW and the United Kingdom 14 GW (Enevoldsen & Sovacool, 2016).

This document is based on a novel approach to clean energy production. Specifically, the role of Earth observation (EO) satellites in maximizing renewable energy production is considered to show the enormous potential for exploitation of sustainable power generation plants when the Earth is mapped by satellites to provide some peculiar parameters (eg solar irradiation, wind speed, rainfall, weather conditions, geothermal data). Within this framework, RETScreen (Canada, 2010) clean energy management software can be used for numerical analysis, such as energy generation and efficiency, pricing, emission reduction, financial feasibility, and risk of various types of renewable energy and energy efficiency technologies, based on an extensive database of satellite parameters. This simplifies initial assessments and provides streamlined processes that allow funders, architects, designers, regulators, etc., to make decisions about future clean energy initiatives. In this paper, the use of RETScreen software is proposed to evaluate a wind energy project in the state of Querétaro. The software divides the evaluation procedure into stages, starts with the type of project, site selection, analysis of meteorological variables, selection of technology, costs and financial benefits, risk analysis and finally determines the economic viability.

Methodology

In this project RETScreen software is used for project evaluation, this software is a clean energy management system for the feasibility analysis of energy efficiency, renewable energy and cogeneration projects, as well as for the continuous analysis of energy performance, The methodology used will serve for the training of future Renewable Energy Engineers of the National School of Higher Studies in the Juriquilla unit (ENES-J) of the National Autonomous University of Mexico (UNAM). Figure 1 shows the RETScreen work process.

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Figure 1 Flowchart
Source: RETScreen, 2020

According to Figure 1, the site data begins, that is, meteorological data and the project to be carried out are requested; The second step is to choose the energy model. In this step, variables such as systems interconnected to the electrical network or isolated are considered; The third stage is the evaluation of the costs in the project, here the initial investment, the debt, the costs for operation and maintenance will be entered and the software will return the financial viability, that is, the payback period, the net present value and the internal rate of return; the fourth stage is related to the amount of greenhouse gas emissions that can be saved with the project; finally the fifth stage is a sensitivity analysis and risk analysis

Project description

A VESTAS V44 - 40m 600 kW capacity 40 m high wind turbine or wind turbine generation plant is considered in the state of Querétaro in the center of the country of Mexico. The initial costs of this wind turbine are $ 1,283 / kW or 770,000 USD, with a tariff of $ 80 / kW. The electricity exported to the power grid is 1,703 MWh and the electricity export revenue is 136,235.52 USD.

The location of the state of Querétaro is presented in Figure 2.

Figure 2 Geographical position of the state of Querétaro, Mexico
Source: Google earth, 2020

RETScreen works with data provided by the National Aeronautics and Space Administration of the United States of North America (NASA for its acronym in English), these data include meteorological variables such as wind speed and global solar radiation, in Figure 3 they are shown these two variables related to each other.

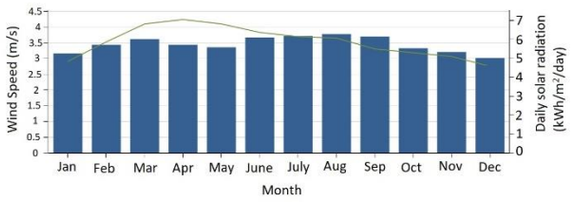

Figure 3 Wind speed and global solar radiation in Querétaro Mexico
Source: RETScreen, 2020

Among the calculations carried out by the software is the determination of the Internal Rate of Return or IRR, this is finding the discount rate that makes the net present value of the patrimony equal to zero. Therefore, it is not necessary to set an organization's discount rate to use this indicator. An organization interested in a project can compare the internal rate of return with its required rate of return (often the cost of capital). The IRR is calculated on a nominal basis (that is, including inflation).

If the internal rate of return is equal to or greater than the organization's required rate of return, then the project is likely to be considered financially acceptable (assuming the same risk). If it is lower than the required rate of return, the project is usually rejected.

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An organization may have multiple required rates of return that will vary based on the perceived risk of the projects. The most obvious advantage of using the rate of return indicator to evaluate a project is that the result does not depend on a specific discount rate of a given organization. Instead, the IRR obtained is project specific and applies to all investors in the project.

Another variable to determine is the project's net present value (NPV), which is the value of all future cash flows, discounted at the discount rate, in today's currency. The NPV is related to the internal rate of return (IRR). Thus, the NPV is calculated at time 0 which corresponds to the union of the end of year 0 and the beginning of year 1. According to the NPV method, the present value of all cash inflows is compared with the present value of all cash outflows associated with an investment project. The difference between the present value of these cash flows, called NPV, determines whether the project is generally a financially acceptable investment. Positive NPV values are an indicator of a potentially viable project. When using the net present value method, you need to choose a rate to discount cash flows to present value. As a practical matter, organizations spend a lot of time and study choosing a discount rate. The model calculates the NPV using cumulative after-tax cash flows.

The model also calculates the net benefit / cost ratio (B-C), which is the ratio of net benefits to project costs. Net benefits represent the present value of annual income and savings minus annual costs, while cost is defined as the equity of the project.

Ratios greater than 1 are indicative of profitable projects. The net benefit / cost ratio, similar to the profitability ratio, leads to the same conclusion as the net present value indicator.

The software calculates return on capital, which represents the time it takes for a proposed facility to recover its own initial cost, based on the income or savings it generates. The basic premise of the simple payback method is that the faster the cost of an investment can be recovered, the more desirable the investment, i.e., in the case of a power project execution, a negative payback period would be a indication that the annual costs incurred are higher than the annual savings generated.

The simple payback method is not a measure of the profitability of one project compared to another. Rather, it is a measure of time in the sense that it indicates how many years it takes to recoup the investment of one project compared to another. The simple repayment method should not be used as a primary indicator to evaluate a project. However, it is useful as a secondary indicator to indicate the level of risk of an investment.

Moreover, the payback period is usually of great importance to individuals or small businesses that may be cash poor. When a company is cash-poor, a project with a short payback period, but a low rate of return, may be preferred to a project with a high rate of return, but a long payback period. The reason is that the organization may simply need a faster payback on its cash investment. The model uses total startup costs, total annual costs (excluding debt payments), and total annual savings and income to calculate simple repayment. The calculation is based on pre-tax amounts and includes any initial cost incentives and grants.

The model calculates the accumulated reduction of greenhouse gases (GHG) during the duration of the project, in equivalent tons of CO2 (tCO2), resulting from the application of the proposed case system (evaluation of the wind turbine).

Results

Table 1 shows the financial results, it is important to mention that the currency used is the US dollar (USD).

Financial analysis		
Rate of inflation	%	4.5
Project life time	year	25
Debt ratio	%	60
Interest rate	%	8.5
Duration of debt	year	10
Startup costs	$	1,223,437
Total annual costs	$	159,539
Electricity export earnings	$	136,236
Financial Viability		
Internal rate of return	%	10.5
Return of Capital	year	13.8
Net present value	$	61,928
Benefit / cost ratio	%	1.1

Table 2

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As can be seen in table 1, the internal rate of return (IRR) is 10.5%, which is interpreted as that the investment is attractive if we compare the IRR with a bank investment rate; The return on capital shows that the project investment will be recovered in 13.8 years and the net present value indicates that at this time the contribution would be 61,928 USD and the Benefit / cost of the project is 1.1 which is interpreted as that the benefits are greater than costs.

Figure 4 shows the cash flow diagram of the project.

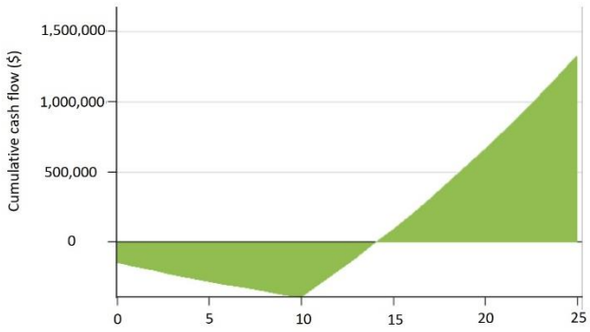

Figure 4 Cash flow diagram
Source: RETScreen, 2020

In Figure 4 the behavior of the cash flow during the project is presented, the net present value at the beginning of the project is observed and that the expenses increase in years 9 and 10, however, between years 13 and 14 the investment and income trend continues until the end of the project.

Regarding the saved CO_2 emissions, RETScreen shows that by carrying out this project, 1,318.2 tCO_2 per year will be saved, which is equivalent to not using 241.1 cars or 566,414 liters of unused gasoline as shown in Figure 5.

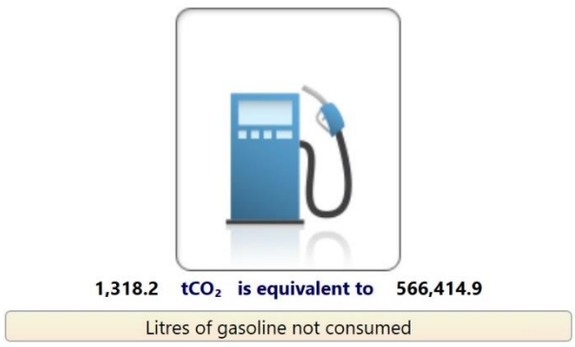

Figure 5 TCO_2 Savings
Source: RETScreen, 2020

The sensitivity analysis is based on the net present value since it is the variable most sensitive to changes, see Figure 6.

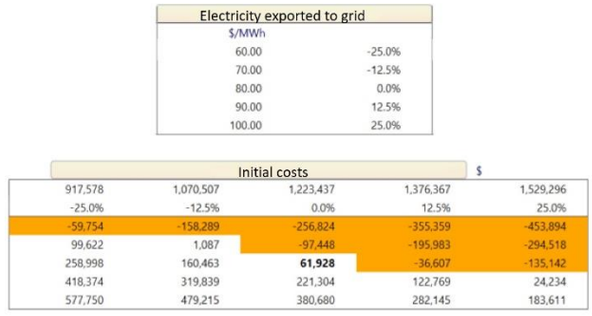

Figure 6 *Reading competence*
Source: RETScreen, 2020

For the sensitivity analysis carried out, it can be observed (Figure 4) that the initial costs vary according to the level of increase or decrease in the export tariff to the electricity grid, that is, as seen in Figure 4, the project It will be viable as long as the electricity export rate does not increase its cost by more than 12.5% as this will cause the initial costs to increase and make the project more expensive.

Acknowledgments

This project corresponds to the Support Program for Projects to Innovate and Improve Education (PAPIME) of the National Autonomous University of Mexico (UNAM) for the authorization of the project PE103520 entitled "Teaching for the design and evaluation of renewable energy projects for the Bachelor of Engineering in Renewable Energies".

Conclusions

The use of RETScreen software presents advantages for the evaluation of renewable energy projects, with the initial conditions of the project, a wind turbine or wind turbine brand VESTAS V44 - 40m of 600 kW capacity of 40 m of height in the state of Querétaro in the center of the country of Mexico. The initial costs of this wind turbine are $ 1,283 / kW or 770,000 USD, with a tariff of $ 80 / kW. The electricity exported to the power grid is 1,703 MWh and the electricity export revenue is 136,235.52 USD.

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With this wind turbine, 1,318.2 tCO_2 per year or 566,414 liters of unused gasoline can be saved.

Financial viability presents information that is used in projects such as the internal rate of return (IRR), which is 10.5%; the return on capital is 13.8 years and the net present value indicated is 61,928 USD, as for the benefit / cost ratio of the project is 1.1.

These results show the techno-economic viability of a renewable energy project using the RETScreen software.

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LKTs as a means of learning English for specific purposes in a virtual modality

Las TAC como medio para aprender inglés con propósitos específicos en modalidad virtual

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Abstract

Learning English implies developing oral, writing, reading, and listening competencies in real contexts to avoid its isolated conceptualization for appropriate communication since the meaning and interpretation of language deal with Semantics and Pragmatics. The study focussed on these objectives: identify the learning and knowledge technologies (LKTs) used in the Semantics and Pragmatics course; know the subjects' perceptions concerning their usage and the findings obtained from their application. Methodologically, a descriptive longitudinal quantitative approach took place, getting these results: identification of LKT resources to promote writing, oral, listening, and reading competencies focused on Semantics and Pragmatics, description of students' perception regarding LKT resources characterized as triggers motivational to learn collaboratively with a positive attitude in their use. The study corroborated that this proposal let subjects grasp the meaning and interpretation of language and achieve a higher proficiency level. In conclusion, LKTs represent a potentially ideal means of learning the language in virtual environments, understanding how they work in context, and acquiring key fundamentals to communicate successfully.

LKTs, learning English, virtual environment

Resumen

Aprender inglés implica desarrollar la competencia oral, escrita, lectora y auditiva en contextos reales evitando su conceptualización aislada, para una comunicación aceptable ya que el significado e interpretación del lenguaje está mediado por la Semántica y la Pragmática. El objetivo del estudio es identificar las tecnologías del aprendizaje y de conocimiento (TAC) utilizadas en el curso de Semántica y Pragmática, conocer la caracterización de los sujetos con respecto a su uso y los resultados obtenidos a partir de su aplicación. Metodologicamente se recurrió al enfoque cuantitativo longitudinal descriptivo encontrando estos resultados: identificación de recursos TAC para promover la competencia escrita, oral, auditiva y lectora enfocadas a la Semántica y Pragmática, descripción de la percepción de los sujetos con respecto a los recursos TAC caracterizados como detonadores motivacionales para aprender colaborativamente con actitud positiva en su uso. También se corroboró que esta propuesta permitió a los sujetos aprender el significado e interpretación del lenguaje y alcanzar un mayor nivel de proficiencia en el idioma. En conclusión, las TAC representan un medio potencialmente idóneo para aprender el idioma en ambientes virtuales, comprender cómo funciona en contexto y adquirir fundamentos clave para comunicarse exitosamente.

TAC, aprendizaje del inglés, ambiente virtual

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Introduction

The contingency that the world is facing derived from the COVID 19 pandemic has revolutionized the way of living, education, and specifically, the teaching-learning process.

The educational system in Mexico has chosen to teach distance classes with the support of learning and knowledge technologies, television programs, the internet, and materials that each teacher from his specialty considers a viable resource for this purpose. In that attempt, higher education institutions have adopted platforms to share content and carry out both synchronous and asynchronous sessions. Nonetheless, institutions and teachers have been overwhelmed by the demands of distance courses that require ad hoc teaching practices to fulfill the purpose of teaching and learning. One of the main obstacles focuses on the selection of learning and knowledge technologies for the design of instructional content appropriate to the proficiency level of students, their learning styles, cognitive, metacognitive, and self-regulation strategies since definitely, the majority of teachers who incorporate information and communication technologies (ICT) use them as a tool without integrating them into pedagogy. In this respect, various studies show that ICT usage in the classroom is low in Europe and North America (OECD, 2004; Bauer and Kenton, 2005; Kessel et al., 2005; Becta, 2006); additionally, Mexico is not an exception.

What is needed is not only the inclusion of ICT in the educational field but also LKTs, which support the redirection of their pedagogical use for an adequate techno-pedagogical design, the selection of technological tools for the generation of synchronous and asynchronous audio-visual resources and learning objects operable on platforms to facilitate the students' teaching-learning process.

In the case of the School of Languages of the Universidad Autónoma de Puebla, specifically in the Semantics and Pragmatics class (context of this research), a study was carried out to identify the learning and knowledge technologies used in the techno-pedagogical design of said subject, the subjects' characterization concerning their usage and the underlying results from their application.

Based on the previous objectives, the following research questions guided this study:

a) What were the learning and knowledge technologies used in the techno-pedagogical design?

b) what were the subjects' perceptions regarding their usage during the Semantic and Pragmatic course in fall 2020?

c) what were the results from the application of LKTs?

Theoretical framework

Learning and Knowledge Technologies (LKTs)

The implementation of technology has modified the teaching dynamics, as it breaks with routine and mechanical work. Besides, it meets students' needs as digital natives, which favors the inclusion of these technologies.

On the one hand, the development of skills in a foreign language requires the design of closely linked activities that privilege the use of cognitive, metacognitive, and self-regulation strategies with a specific purpose, avoiding rote learning. On the other hand, said design must be perfectly aligned with continuous and formative planning and evaluation of its actors: students and teachers (Casanova, 2009).

According to the literature review, for different authors (Balanskat, Blamire & Kefala, 2006; Galanouli, Murphy & Gardner, 2004; Orellana, Almerich, Belloch, & Díaz, 2004), the teachers who incorporate LKTs in the teaching process must have positive attitudes towards their integration. Thus, as teachers, we must face this challenge, meet these technological needs and innovate in the teaching English process.

In this context, the innovation factor is decisive to make the difference between a passive and mechanical or active class with meaningful learning to achieve the purposes established in an English class since this does not depend solely on the technological resource used in it, but rather the techno-pedagogical design carried out by the teacher because he is responsible for directing the digital tools.

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At this point, Cortes-Ocaña (2013) explores various technological resources and makes contributions to the inclusion of LKTs as a need that demands a change in the roles of educational actors by requiring new competencies to use technologies in educational environments. She also highlights that the implementation of LKTs in didactic planning is necessary to achieve pedagogical excellence because they become generators of didactic activities that enhance fundamental English skills and knowledge.

Gualdrón (2015) suggests that LKTs are new ways that provide possible uses of ICT in education with a pedagogical added value. The author affirms that the pedagogical implementation of ICT transforms teachers into an LKT instrument to the deconstruction of English knowledge. She also ensures that knowing ICT provides teachers skills to implement pedagogical technologies in-class activities and achieve the learning purposes. Moreover, it allows students to appropriate, understand, improve and streamline their learning process.

For Cabrero (2015), LKT is the implementation of ICT as learning tools and knowledge production. According to Enríquez (2012), as cited in Pinto, Díaz & Alfaro (2016, p. 40), "they are the product of the genuine and meaningful uses of ICT, intending to improve learning, creating dynamics and training practices that compromise the investigation of the various didactic usages of digital technology".

Regarding the above, the implementation of ICT under a pedagogical scheme makes the student take responsibility for their learning process, and the teacher adapt the use of LKTs in their didactic planning, providing students with a dynamic tool of the educational process.

According to Delgado (2019), LKTs promote change in learning the English language and affirms that the teacher is responsible for developing planning based on didactic strategies to achieve the established purposes. Likewise, the author considers that learning English requires the activation of various senses, which can be stimulated by the implementation of LKTs.

IEAE (2007), Korte and Hüsing (2006) point out that the LKTs promote values, which motivate the student by creating an interactive environment, stimulating their senses, providing innovative and attractive spaces, promoting the learning and achievement of English skills.

The implementations of LKTs in content or general courses and didactic plannings promote fundamental skills such as the ability to process information, develop writing and reading skills in a dynamic, interactive, and innovative way (Marqués, 2000).

Learning English in a virtual environment

Virtual education involves technology implementation to meet digital needs and positively contribute to student learning and performance.

Besides, its application requires different elements like a rigorous process of selecting LKT resources, adapt them to didactic planning, rethinking the roles of educational actors (teacher and students), and the most important, willingness to make such a remarkable change. Pastor (2005) affirms that virtual education has a double intention: cause and consequence for a change.

A virtual environment creates an ideal environment for relationships. For that reason, it must be treated in a different way to achieve its effectiveness (Duart, n.d.). It leads to synchronous or asynchronous communication in another space than the classroom for intentional training purposes that promote autonomous learning and thinking (Unigarro, 2001).

For Zuñiga & Carrasco (2012), the materials or resources to be implemented and the availability of technology are the main elements in virtual education as a means of communication per se between the student-teacher and the tool to appropriate knowledge.

In the case of learning English in the virtual modality, studies conducted by Soto (2019) and Román (2017) conclude that students who learned the English language through a virtual environment recognize that the effectiveness of their learning depends on well-structured content easy to understand, distribution of time, discipline and self-motivation.

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For Ávila, Arnaiz & Arias (2015), the practice of English in virtual environments demands constant interaction between students with the implementation of Web tools that request tasks according to the established purposes and contribute to the development of oral communicative competence of English.

Besides, on the one hand, according to Nguyen (2010), for learning English virtually, the communicative approach is essential because this implies addressing contextualized, meaningful, and original learning activities. On the other hand, Corrales (2009) affirms that adapted linguistic input must attend to study students' needs, purposes, and previous knowledge to help them work on those particular spaces.

Chaves, Chaves, and Rojas (2015) point out that innovative strategies to learn English in a virtual environment meet learning needs, develop multiple intelligences and promote different learning styles because they also build and reconstruct knowledge, foster communication skills, critical thinking, and favor an academic performance.

Another of the benefits of the virtual modality is that students control the environment that satisfactorily influences their language learning process, self-manage the time they spend to carry out learning tasks, and generate a meta-cognitive self-regulation process (Marulanda, Ramírez, Londoño & López, 2018).

According to Saavedra & Robledo (2016), virtual learning promotes cognitive skills such as creating, applying, understanding, knowing, and analyzing; indicators that motivate students to read, write, express their points of view and awaken their creativity in the learning process.

According to the studies mentioned above, theoretically, LKTs represent a viable instrument for teaching virtual classes and learning a language for either specific or general purposes, all under a techno-pedagogical design.

Methodology

For analyzing this study phenomenon, the quantitative approach of longitudinal cut and descriptive scope was used during the autumn period of 2020, taking into account that this allows an objective analysis concerning a social fact using questionnaires, representation of results in tables or graphs (Rodríguez Peñuelas, 2010) and statistical analysis (Hernández, Fernández, and Baptista, 2010).

The sample consisted of 30 subjects belonging to the same semester of the educational program with synchronous and asynchronous virtual classes 4 hours a week in each modality, respectively.

Analysis model

The previous research questions are the basis of the analysis model.

Research question	Instrument
What were the learning and knowledge technologies (LKTs) used in the techno-pedagogical design?	Analysis of the techno-pedagogical design and identification of LKTs.
What were the subjects' perceptions regarding the use of LKTs during the course in fall 2020?	A Likert-type scale questionnaire took place to measure the subjects' perceptions regarding the degree of usefulness of the LKT resources to learn Semantics and Pragmatics, and in general, English as a foreign language.
What were the results from the application of LKTs?	Subjects took a standardized test to measure their proficiency before learning with the techno-pedagogical design and after it.

Table 1 Analysis model
Source: Own elaboration

The data collection process is detailed below.

1. The standardized test was applied to know the level of proficiency before starting to work with the pedagogical design.

2. The LKTs used in the course were identified through a detailed analysis of the techno-pedagogical design.

3. After identifying the LKTs used in the course, a 50-item Likert-type scale questionnaire was designed and applied to subjects to know their perceptions of the LKTs.

4. The standardized test was applied again to realize the underlying results of the application of LKTs in the teaching-learning process.

Findings

These are the results from the previous analysis model.

Learning and knowledge technologies (LKTs) used in the techno-pedagogical design

In the Semantics and Pragmatics course, subjects used various LKT resources to learn the meanings of words in different contexts, and as a result, the interpretation of the language.

Competence	LKT resources to learn semantic and pragmatic fundamentals
Oral	Quick, 123 apps, zoom, blogger, and Edpuzzle
Writing	Google Docs, Padlet, Microsoft Teams, Pixton, and Storybird
Listening	Vocaroo, PodBean, and Audacity
Reading	Piktochard, Easel.ly, and Genial.ly

Table 2 Learning and knowledge technologies used in the techno-pedagogical design

Subjects' perceptions regarding the use of LKTs used in the techno-pedagogical design during the Semantics and Pragmatics course, Fall 2020

Oral competence

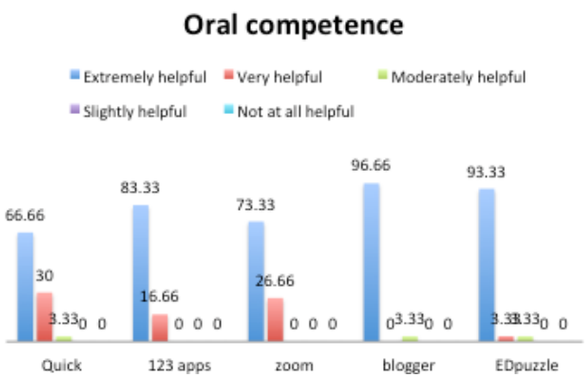

Figure 1 Oral competence

As can be seen, most of the sample perceived LKT resources as extremely helpful tools in their process of learning semantic and pragmatic elements.

Subjects indicate that LKT resources satisfy their audio-visual learning style and foster their learning process. It corroborates the results from Flores-González' study (2020), which mentions the necessity to align an instructional design mediated by ICT to the content pedagogically to engage students on authentic-interactive activities in their learning process.

Regarding the Quick digital video tool, 66.66% stated that it is extremely helpful, 30% very helpful, and 3.33 moderately helpful. In this case, the subjects pointed out that the app is easy to use for creating situational videos that enrich their learning process and let portability of audio-visual materials at different times, platforms or repositories.

About the 123 app resource, 83.33% described it as extremely helpful, and 16.66% as very helpful for developing oral competence and learning about semantic relationships in authentic and non-authentic contexts. It is worth mentioning that the most remarkable features of this tool are the single browser and its benefits to edit, modify or combine audio and video.

Moreover, 73.33% of the subjects pointed to Zoom as an extremely helpful tool and 26.66% as moderately helpful because, during the practice of oral competence, it allowed them to select the correct register or code and apply suitable norms to each situational issue and context (courtesy, irony, or humor), attitudes, and formal knowledge in addition to using non-verbal language as support for their discourse due to its video and audio modality.

Blogger was the LKT resource perceived as the most useful by the sample, which indicates that the design of the activities based on the LKTs guided the subjects to identify their communicative and receptor intention to use the appropriate resources (system interdependent codes) for successful oral communication.

Finally, EDpuzzle was the second LKT resource identified as extremely useful for learning semantic and pragmatic content in the oral competence.

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The subjects indicated that their benefits of editing videos represent ad hoc means for learning and analyzing semantic and pragmatic foundations in real and natural situations or for modifying the videos available on the web for educational purposes, which support the comprehension of the above-stated elements promoting their identification at the time of use.

Writing Competence

Figure 2 Writing competence

The figure points out the Google Docs tool as useful (95%) to promote collaborative work in the construction of pragmatic writings to show how the context, interpersonal relationships, and the prior knowledge of the actors influence the interpretation of the meaning of language by using free digital tools available on the web. Indeed, the subjects assert that the app motivated interactive work and collaborative learning in virtuality, as pointed out by Ávila, Arnaiz & Arias (2015), Korte and Hüsing (2006), and IEAE (2007).

Regarding the Padlet resource, 98% of the sample consider it as a useful means to energize classes and turn a theoretical session into something more practical with meaningful and collaborative learning with elements of text, photos, video, and audio to satisfy the subjects' learning styles, the center of the teaching-learning process in the present research and techno-pedagogical design.

The Pixton app represented 95% of usefulness for the subjects when writing with humorous, ironic, and persuasive overtones, evidencing semantic and pragmatic foundations appropriate to the situations of each scene of the comics. However, the Storybird app was considered more useful compared to the previous one (98%).

The results also show that learning English requires the decoding and encoding texts from pragmatic elements to achieve suitable written communication.

Finally, the Microsoft Teams platform linked to the present techno-pedagogical design was conceptualized by 100% of the sample as extremely helpful in the proper choice of semantics to express irony, courtesy, metaphorical and poetic language unambiguously in writing.

Listening competence

Figure 3 Listening competence

According to the figure, three LKT resources are essential for learning semantic and pragmatic principles orally: vocaroo, audacity, and podBen.

In the particular case of vocaroo, on the one hand, 75% of the sample recognized it as a useful app, especially to promote pragmatic aspects in conversations and use the language in communicative, social, and situational contexts authentically and naturally. On the other hand, 25% considered it as moderately helpful that implies this LKT resource does promote subjects' learning process proactively with bold and creative actions to generate meaningful and meta-cognitive learning.

Regarding audacity, 97% identified it as extremely helpful and 3% as very helpful respectively due to the advantages it offers to edit audio in real-time with sound effects such as echo, tone, and inversion, which allowed to create real situations with suitable semantic and pragmatic elements, communicate what the sender really wanted and thus, obtain an objective interpretation of the messages by the receivers.

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PodBean was the most accepted (99%), concerning its usefulness, thanks to its ease of use, functions as a video, audio blog creator, and aggregator.

These results confirm the assertions of Serra et al. (2000) regarding the importance of pragmatics in the communicative act by describing it as the skills, linguistic and cognitive knowledge that leads to the proper use of the language in specific situations; essential aspects that can be taken to the field of virtual practice and learning through LKTs.

Reading competence

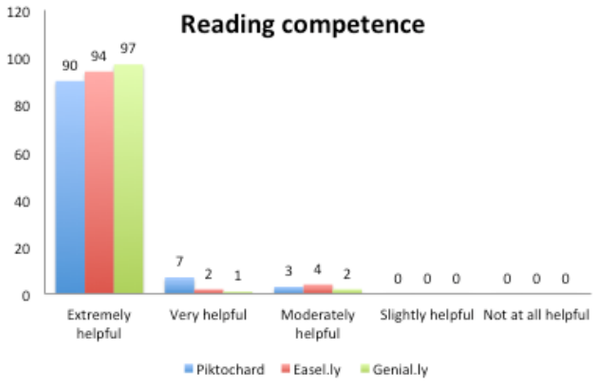

Figure 4 Reading competence

The information indicates that in the process of learning semantics and pragmatics with readings, subjects used three LKT resources: piktochart, easel.ly, and genial.ly

Piktochart registered 90% of usefulness according to the subjects' perceptions, followed by 7% as very helpful and 3% as moderately. It means that infographics contribute to the students' learning process because they can depict their comprehension of pragmatic and semantic concepts and highlight relationships between each element by using them.

Another app accepted as extremely helpful for acquiring and understanding knowledge was Easel.ly (94%). This tool encourages the presentation of information on murals with a global perspective on the subject in a summarized way. Besides, it allows students to visually notice different semantic elements as reference, denotation, and development of lexical relationships between words, for instance, synonymy, antonymy, hyponymy, homonymy, polysemy, paronymy, metonymy, and placement.

Last but not least is Genial.ly. In this regard, 97% of the subjects indicated that it was helpful, and 2% moderately since it guided them in the analysis and synthesis of information for its visual presentation in a great variety of templates according to the topic. In reality, the sample perceived the format as a motivational tool (Saavedra & Robledo, 2016) to develop cognitive skills, understanding, and learning about terms extracted from texts. For example, denotative, connotative, literal, and figurative meanings, deixis, speech acts, conversational implicature, courtesy, irony, and humor.

Findings from the application of the LKTs

A standardized test was applied to measure the subjects' proficiency and estimate the results of the application of LKTs with the learning of English as a target language.
The table shows the level they had at the beginning and the end of the course.

Proficiency level

Before		After	
Subjects	Proficiency level	Subjects	Proficiency level
12	A2+	12	B1
13	B1	9	B2
		4	B2+
5	B1+	5	B2+

Table 3 Findings concerning the use of LKT resources in the learning process

The findings show a considerable improvement in the subjects' proficiency level of the target language. It implies that virtual learning environments focus on LKTs mediated by ICTs provide appropriate content to students according to their learning styles. They also develop an independent user and allow them to learn formative knowledge with specific purposes as in this research.

Finally, in this virtual modality, the teacher's guidance and support are essential to select information because the LKTs by themselves do not help them choose the appropriate one.

Conclusions

The following conclusions are drawn based on the results:

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In the first place, the study accomplished the three objectives and are described as followed: the learning and knowledge technologies used in the Semantics and Pragmatics course are 16 LKT resources grouped according to the competence they developed in each segment. There is also a subjects' characterization regarding the use and usefulness of LKTs, highlighting blogger, Microsoft Teams, audacity, and genial.ly for learning semantic and pragmatic fundamentals. Finally, the results obtained from the application of LKTs showed that the techno-pedagogical design also contributes to mastering the language as a target language.

Secondly, there is a high positive perception towards the use of LKTs, being evident in the students' work and activities, which show a greater fulfillment of tasks, proactive attitude, and high rate of correct exercises.

Third, these technologies are motivational activators to work and learn collaboratively in a virtual community.

Finally, the LKTs applied to virtual educational contexts represent a possibility to understand semantics and pragmatics, that is, the meaning and interpretation of language in varied contexts, and above all, meaningful for students.

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Methodology
Contribution

Keywords (In Spanish)

Indicate 3 keywords in Times New Roman and Bold No. 10

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* Correspondence to Author (example@example.org)
† Researcher contributing as first author.

Introduction

Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

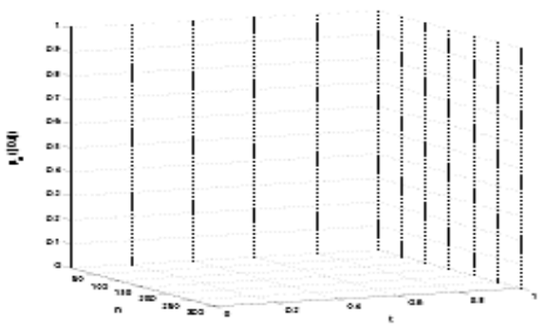
[Title No.12 in Times New Roman, single spaced and bold]

Products in development No.12 Times New Roman, single spaced.

Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



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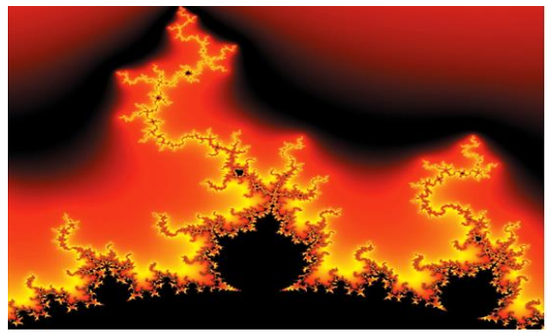

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Each article shall present separately in **3 folders**: a) Figures, b) Charts and c) Tables in .JPG format, indicating the number and sequential Bold Title.

For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \quad (1)$$

Must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the article.

Annexes

Tables and adequate sources

Thanks

Indicate if they were financed by any institution, University or company.

Conclusions

Explain clearly the results and possibilities of improvement.

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Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the Article.

Use Roman Alphabet, all references you have used must be in the Roman Alphabet, even if you have quoted an Article, book in any of the official languages of the United Nations (English, French, German, Chinese, Russian, Portuguese, Italian, Spanish, Arabic), you must write the reference in Roman script and not in any of the official languages.

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Each article must submit your dates into a Word document (.docx):

Journal Name
Article title
Abstract
Keywords
Article sections, for example:

1. Introduction
2. Description of the method
3. Analysis from the regression demand curve
4. Results
5. Thanks
6. Conclusions
7. References

Author Name (s)
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