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In Pro-Research, Teaching and Training of human resources committed to Science. The content of the articles and reviews that appear in each issue are those of the authors and does not necessarily the opinion of the editor in chief.

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Teaching solar energy harvesting based on an educational solar cell, information technologies and basic electronics

SALINAS, Oscar†*, DÍAZ, Fernanda, LUNA, Martha and CABALLERO, Alejandro

Universidad Tecnologica Emiliano Zapata del Estado de Morelos

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Abstract

Harvesting energy and photovoltaic effect was learned using a basic electronic circuit and an educational solar cell. Teaching and understanding concepts related with physics phenomena, semiconductor theory, electronics circuits and mathematical analysis is not a simple issue since soften students think those are very difficult by nature. The idea was move the students in the way to put hads on, it means built some cheap tools to understand the process involved in a solar cell to perform energy harvesting from Sun. Pothovoltaic effect is the concept behind the solar cell performance. Students were able to discover that around this concept there are important science and technological topics related; also they realize the importance of mathematics in technological development and the creation of new devices or applications. During the construction of low cost technological tool, students discovered for themselves, how and why the climate impact positively or negatively on the performance of harvesting energy from the sun through a solar cell. Interaction between electromagnetic energy and matter was understood and the way that scientific and technological knowledge can be used to develop low cost pedagogical tools to improve teaching – learning process.

Teaching – learning process, energy harvesting, Irradiance level

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Introduction

For students of Engineering Information Technology Physics is not only difficult but also stranger topic is opposite to their field of knowledge pole. They do not believe it has anything to do because the academic approach has not allowed sensitize young IT students about the importance of physical concepts and mathematical theories related to them. Electronics is a branch of physics; the vast majority of IT currently uses electronic devices. It is very familiar to them using wireless communication networks, in college, at home, in shopping malls, entertainment centers, and street and in some cases their workplaces; but it is not as familiar with the concept electromagnetic wave, wavelength, angular frequency, refractive index, and so on.

If something as used by them, as wireless telecommunications networks do not relate to physics, is even more the case of harvesting solar energy by means of a cell. Physics is behind the conversion of solar energy into electrical energy and how you can take advantage of. It is also currently widespread use of renewable energy, even is already common to see solar cells in public telephones, and almost public domain, which are used to power electronic devices, but what about the operation of the cell, and that learning that it can serve the student iT? It's an interesting question to answer, but especially to arouse interest in young people to learn the concept of energy harvesting, because the same can be done with the energy that sends a wireless network using a rectenna. The entire process of generating electricity from energy harvesting is defined in three steps, Fig. 1.

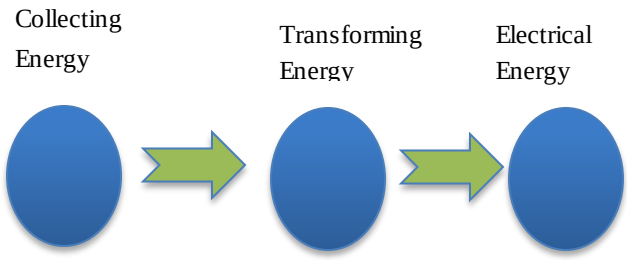

Figure 1 Steps to generate electrical energy from harvesting

What is interesting is how from this simple scheme, you can go analyzing the complexity behind each step, convincing the student IT with the knowledge gained and the needed acquire can understand the process of transformation energy and the importance related to renewable energy, sustainable technological development, and commitment as a technologist, but more like human being has with the planet earth. In the first step, a transducer collects energy. For almost all activities undertaken by most humans, they need electricity, so that the generation and distrubición of the same has to be very efficient. This has become one of the main challenges to overcome. It is necessary to employ generation techniques that are friendly to the environment, is the case of renewable energy or clean energy. For this reason it is necessary that any technologist knows the importance of them and the need to use them, but also how they work some of them, to have the judgment of discrimination in employment as appropriate.

Technologists and Scientists are continuously aiming their activities to find new sources of clean energy; Two of them are the well know solar energy harvesting using solar cells (Salinas, Estrada, & Luna, Energía Limpia con Celdas Solares, 2012) (Sze & Kowk, 2007). Other one of new energy sources is Space Solar Power (SSP) according with according to the scientific and technological community is the promise sustainable energy source for mankind in near future.

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This one works under the Wireless Power Transmission Concept (WPT) (Agbinya, 2016). A transducer is a device that converts one type of energy into another. In the case of solar energy, the transducer is the solar cell, which is a transducer device that converts sunlight into electricity. Rectenna is a transducer device that converts electromagnetic energy into electrical energy.

Solar cell works under the physical phenomenon called Photovoltaic Effect. The solar cells convert electromagnetic energy into electrical energy, generating an electric potential (voltage) between its terminals. This process of energy conversion is based on the photovoltaic effect (Rappaport, 1959), which is why they are also known as photovoltaic devices. Albert Einstein in 1905 (Einstein, 1905) and Walter H. Schottky in 1930 gave a deep understanding of the scientific principles of the interaction of light with materials and physics of semiconductors, respectively.

In both cases mentioned above, is implicit electromagnetic energy concept that IT student if related to their field of knowledge. However it may not be demasido Emphasize the importance of getting to know the behavior of this energy and its interaction with matter. This knowledge is the immediate relationship of wireless technology with physics as a result. So it is necessary for learning techniques that are effective and attractive to students, one of them is do it yourself (DIY) employed.

It must be clear that the objective is that the student understands what you are trying to learn, so it can make value judgments about the results they are getting. If the pretension is that students learn simple, imples things, teaching can also systematize simply, identifying tasks that teachers should routinely apply.

If it is to develop skills and more structured and transversal competences, it is necessary to apply techniques to meet the objective. There are several examples on the subject reported in the literature, however many of them are focused on virtual labs, software and physical laboratories with open source hardware (Salinas, Angel, Luna, & González, 2014) (Salinas, Estrada, Luna, & González, Developing Mathematical Literacy, Based on Elemental Software and Academic Tools Development, 2013). The initiative to use solar cell for teaching physical concepts behind energy harvesting through any device, emerged from previous work that was done in the institution. This paper presents a Solarimetric station was built based on hardware and open source software (Salinas, P.J., Estrada, & Luna, 2013).

Based on own and others experience one hyphotesis can be enunced:

Deep understanding abput physical concepts behind energy harvesting can be getting based on the experimentation.

The academic solar cell was used to work as a pyranometer, which is the device used to get Irradiance level information.

Methodology

The first step is to teach how a solar cell is, and how it works in general as a transductor, Fig. 2.

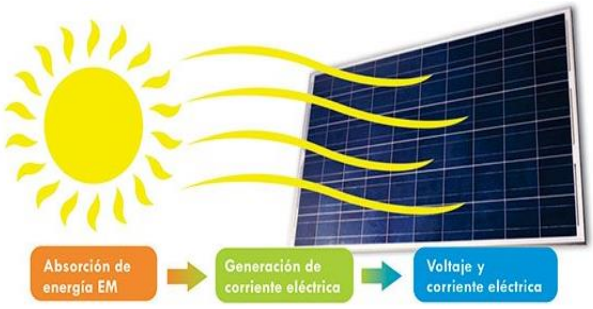

Figure 2 General view of how a solar cell work

The parameter that qualifies how efficient the solar cell works as a transducer is the Power Conversion Efficieny (PCE) (Sze & Kowk, 2007). It indicates the percentage of the solar energy was converted to electrical energy. Is important to clarify to the students that in every energy conversion there are losses, not all energy is converted in the one is desired (Goswami & Keith, 2007). In the field of solar cells not al Electromagnetic Energy that incides over its surface is converted into electrical energy, due to internal and external factors. If the losses are seen as resistance, valid approximation, TI student understand the general idea. Solar Cell I – V curve, Fig. 3.

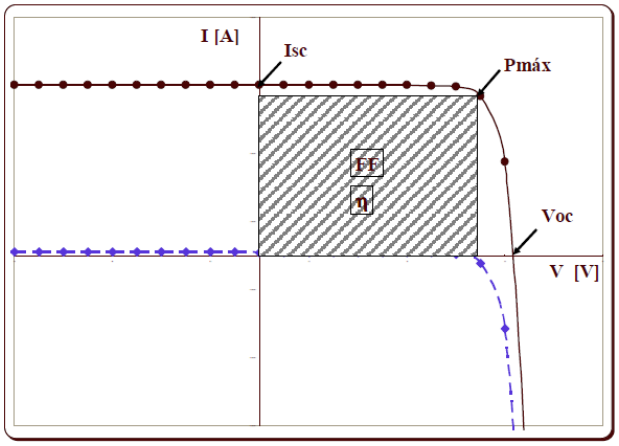

Figure 3 Learning solar cells PCE concept base on electrical circuit behavior

The maximum power point (Vm, Im) is the one where the "resistence" is low and the conversion is higher. A valid analogy is the Antenna behaviour: resonance frequency (Balannis). A calculus worksheet was used as TIC tool to teach and understand the antenna maximum transferring point, Fig. 4 (UTEZ, 2014). The relationship between PCE of a solar cell and antenna resonance frequency is done base on the behaviour of a simple electrical circuit, and the parameter of resistence. Because resistence si all that is opposing to the flow of current or all things opposing to energy conversion.

Pm point is therefore the one where solar cell is converting most efficiently the solar energy.

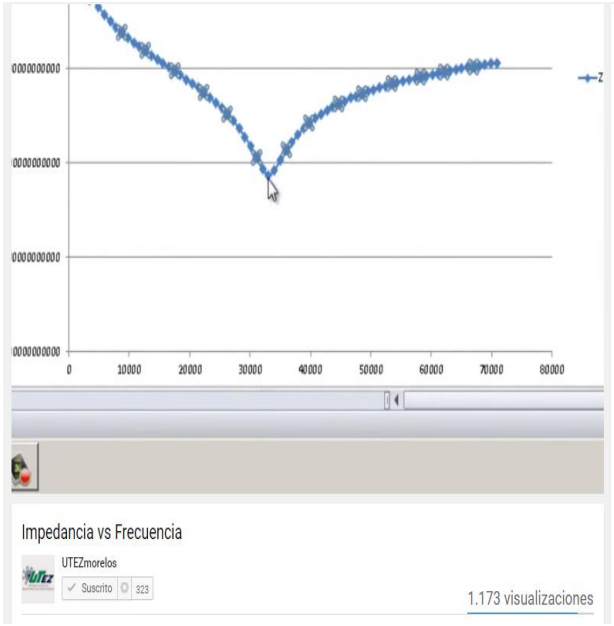

Figure 4 Maximum energy transfer: antenna resonance frequency

Figure of merits of a solar cells are the open voltage circuit (V_{OC}) and short circuit density current (J_{SC}) (Salinas, P.J., Estrada, & Luna, 2013):

$$V_{OC} = \frac{nkT}{q} * (ln\frac{I_L}{I_0} + 1) \quad (1)$$

$$J_{SC} = J + J_0(e^{\frac{q(V)}{nkT}} - 1) \quad (2)$$

And the equation including resistance effects, is (Sze & Kowk, 2007):

$$J = J_L - J_0\left(e^{\frac{q(V-IR_S}{nkT}} - 1\right) + \frac{V-IR_S}{R_{Shunt}} \quad (3)$$

It means the three basic electrical parameters of simple electrical circuits, are called to understand losses ar solar cell and the relationship of electrical resistance and PCE.

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Therefore electrical resistance is not the only parameter that affects the PCE level. First measurements of V_{OC}, J_{SC} and Pm, the educational solar panel and a multimeter that can record the data automatically were used, Fig. 5. Students record the behaviour of the solar irradiation during the day for one week, panel was angled according with latitude and altitude coordinates of the campus.

Once this concept of losses is understood the next step is to teach it under basic physics of semiconductor devices, Fig. 6. Electromagnetic energy could be view as a wave and also as a particle, but this is a concept that needs special treatment, for the purpose of this job with the photon concept is enough.

Photon has energy depending on its wavelength (Sze & Kowk, 2007). Photon Energy (hf) needs to be higher than the electrical band gap (Eg) to electrons jump form the valence to the conduction band.

Figure 5 Measurement of electrical figure of merit of solar energy conversion

Once it is happened electron – hole (e – h) pairs are created, and as a consequence they are going to be separared by an internal electrical field.

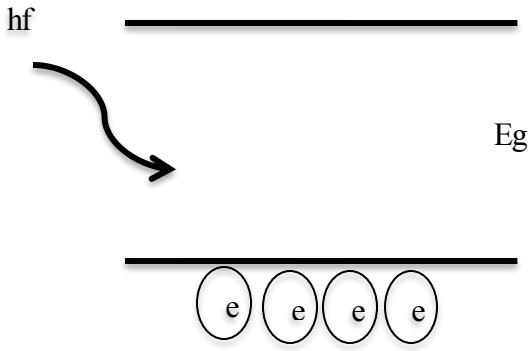

Figure 6 Concept of resistance applied to photon energy and semiconductor band gap interaction

Two important things: not all the incident photons generated e – h pairs, and since semiconductor is no an ideal electrical conductor not all separated e – h pairs are going to be collected at solar cells terminals. It means there are some resistance to energy conversion and there are losses to forbid the 100 % efficient.

Results

As part of this job, students got a deep understanding of physics behind the energy harvesting form solar cells. TI students also got abilities about technical equipment use, and develop adademic competences as research skills, discrimination about their knowledge sources, autocritical sense, autonomous work, and so on. Some others academic tools were developed as part of the work, these ones are based on calculus worksheet (videos utez), Fig. 7, Fig. 8.

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Physical concepts behind the technological tools are well understood using simple and free tools. Low budget universities need to look for options to develop complex competences in the students.

Also a correlation analysis and a low cost solarimetric station were constructed (Salinas, P.J., Estrada, & Luna, 2013). The value added of this work is the use of open source of software and hardware, and the web site view, Fig. 9

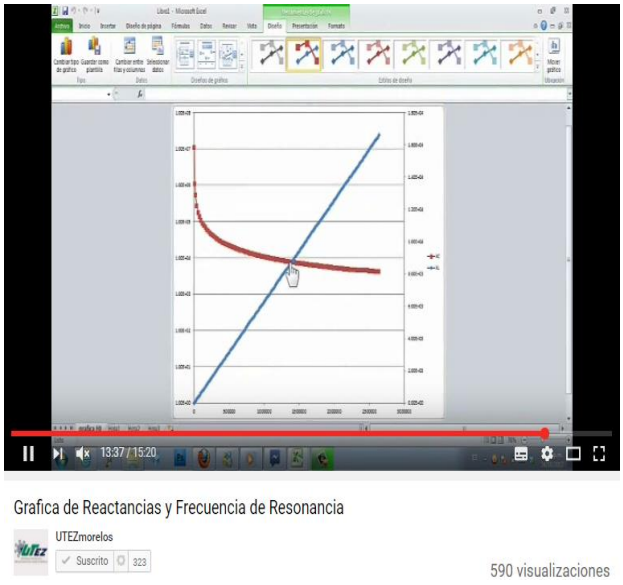

Figure 7 Concept of resistance applied to photon energy and semiconductor band gap interaction

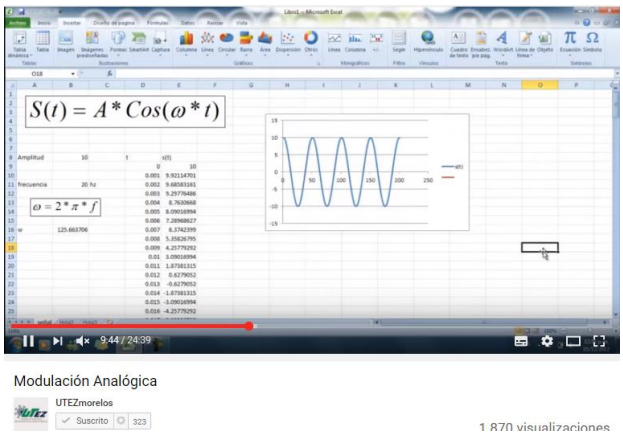

Figure 8 Web view of UTEZ solarimetric station

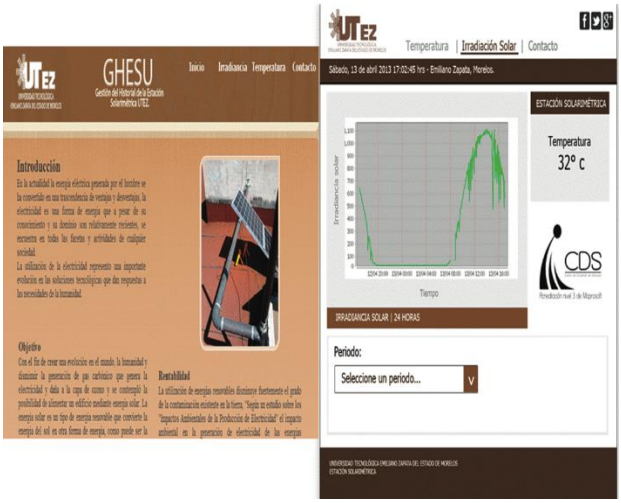

Figure 9 Web view of UTEZ solarimetric station

Conclusions

DIY techniques are efficient and useful as an aid in the teaching process - learning. The student engages in the development of a prototype, from conception of the idea, design or experiments, to the analysis of the final behaves. It understand the elements that compose it, and the role of each of them acquires the culture of the trial, questioning, trying to answer for itself the questions that arise in each of the activities.

Another skill that develops the student learning under this scheme is the researcher, is he who seeks information sources on the subject, aquiriendo with this judgment of choice, learns to discriminate which of these sources actually provide scientific information, supported with solid theoretical arguments, and which does not provide the necessary knowledge. Students learn to integrate knowledge acquired in the classroom, learn to relate topics and give importance to basic science.

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No still sees physics as a matter totally alien to their discipline of knowledge rather sees it as a theoretical support to support the ideas that acquires. In the case of mathematics is a similar process, the student begins to understand the power of this tool, and the great usefulness, not only in scientific, but also in the technological aspect. Physics and Mathematics, in this case, interacting playing together for the development of technology, resulting in the world, as we know it today.

It is an academic completely obtained under this scenario (DIY) as in the development of technological prototype or any kind of prototype, they are getting valuable work products, such as manuals, educational tools, design practices and equipment teaching in general that it can be used in subjects related to the subject.

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Matrix for the Analysis of Teaching Practice by Graduate Students

DE LA RIVA-LARA, María de Jesús†*, PAZ-RUIZ, Vicente and AGUILAR-HERNÁNDEZ, Luz Guadalupe

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Abstract

Procedure outlined in this article is part of a mixed qualitative research that aims to assess impact of the Masters in Basic Education with specialization in Science (MEB-RCTS) in educators. Categorial matrix, indicators and codes designed for analyzing video recordings of educational activities by students, are applied at the beginning and the end of their studies because it is considered that the intervention is an ongoing process. Data are processed through indexing and transcription techniques. Written report are generated from key points and focal events categorized into four argumental lines: 1) Co-construction of curricular content of Biology, Physics and Chemistry. 2) Social, literary and material Technology. 3) Instructional framework of scientific competences. 4) Teacher responses to the conditions of school environment. Comparable narrative descriptions are generated with relevant quotations from verbal and nonverbal interactional phenomena. Results obtained in process will be compare with the others stages: profile entry and exit, needs of beneficiaries, content of thesis, survey and interview graduates, allowing assess transformation of their agency and training skills involved in graduate school.

Teaching practice, graduate students, curriculum evaluation, video research, science teachers

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Matrix for the analysis of teaching by graduate students

This is a mixed qualitative research in 5 stages intended to evaluate the impact in the professional development of the students from the Master in Basic Education with specialization in Reality, Science, Technology, and Society; MEB-RCTS for its initials in Spanish (UPN, 2010; Gómez, Rodríguez y Ruiz, 2015; De la Riva, Rodríguez, Ruiz y Paz, 2015).

The students are preschool, elementary and middle school science teachers working in Mexico City and Mexico State. The MEB-RCTS is a professional oriented graduate program, so it is outstanding that the student-teachers combine the workdays in the classroom with reflection and analysis sessions in the graduate program. This gives a broader perspective of the educational phenomenon and the possibility to make a formative intervention. As the students acquire a graduate education, their teachers' competences in the teaching of science are improved, and the teacher meets the learning necessities of the classroom.

Before entering to the MEB-RCTS the student-teachers already have a professional practice and a set of competences from that community. They share the traditions of the profession, an explicit common core professional knowledge, a value system organized in institutional levels, which takes place in the same reality. The practice is problematized and a mediation tool is designed parting from this background through collective debates in seminars, tutorial comities and intergenerational encounters that allow the student-teacher to re-signify the practice.

The student-teachers reconsider their intervention projects continuously as they produce abundant evidence of their progress. Some of the evidences are: the description of the context in which the practice is developed, the learning characteristics and changes in the beneficiaries (kids and teenagers students going through basic education), and the knowledge; abilities and attitudes that the teacher builds along the process. The evidences are present in the different written versions of their theses. Within the evidences, those that depict their reflective thoughts and decisions are outstanding; and they become a valuable information source for the investigation of the MEB-RCTS's impact.

While in the first stage (population characterization), second (knowledge) and fourth (written production) the data for the investigation is taken from individual cases, the third (practical) and fifth (focus interview) analyze the group situations.

Objective

The third stage of the research tries to answer the question: How the practices of the beneficiary teachers change with their studies in the graduate program? Its objective is to evaluate the impact of the program in the improvement of the student-teachers practices.

Method

This article shows the material made during the third stage, in respect with the design process of the matrixes for the characterization and analysis of the teaching practice in the intervention.

The first step is to characterize the practices, their changes and the improvements in relation with the competences intended in the graduate profile.

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It is focused in the teaching activities as interactive systems in which persons, objects and events take place to support a learning environment of scientific contents in a specific context. These interactive systems are complex, dynamic and difficult to grasp at first stance, which makes insufficient an individual analysis of each of its components.

Intervention is an on-going transformational process that is constantly re-shaped by in own internal organizational and political dynamic and by the specific conditions it encounters or itself creates, including the responses and strategies of local and regional groups who may struggle to define and defend their own social spaces, cultural boundaries and positions within the wider power field. (Long, 2001, p.27) (Cited by Engeström, 2011, p. 604)

It becomes necessary with these characteristics that the analysis units are interactive systems with a spatial, temporary and situational delimitation. The demarcation that the student-teachers make from their own reality is taken as a reference. For example the intervened and analyzed practices, the authentic problems experienced every day in the classroom, those related with the student's necessities like health; environment, the interest in science, the collaborative participation in inquiry activities and the experimentation and understanding of natural phenomena, the application of scientific concepts, the adaptation of the working materials, etc.

In order to take the classroom problems to the seminars different technics have been used, as well as instruments in agreement of the current MEB-RCTS teachers; usually a field diary, class videotapes, checklist, and the observation checklists. For further scrutiny it is needed a diagnose that highlights the different aspects, necessities, deficiencies, absences, barriers, best practices, mediation types, styles, etc.

The videos are used to problematize, make a diagnostic and depict the changes in their practices. For our research these videos are useful to portray their practice and to evaluate if those changes are an improvement and attributable to the MEB-RCTS.

In the third stage, the analytical units are thematic. They take as criteria the notion of activity whether they require one or more videos.

In this case activity is understood as a teaching sequence with a thematic and organizational unity. Each activity involves a new instruction series by the teacher and the theme, the working material or the procedure followed by teacher and students change. Inside a classroom several activities can coexist (Gálvez, Rockwell, Paradise y Sobrecasas, 1981, p. 17).

The activities take into account the curricular pedagogic principles, the school's specific organization and the teacher´s experience. The school activities can relate with other activities forming cycles. Furthermore, those activities' cycles can take place in one or more class sessions. The activity cycles are a form of intertextuality because the meanings built along an activity are connected with the meanings of other activities. In order to delimit each analysis unit the written materials that give it context are checked. This information and the video transcript is the first step to obtain the data. In this research, the *transcription* is understood as an interpretative and representational process (Green, Frankiz y Dixon, 1997, p. 172) taking into account the theoretical perspective that leads the analyst to pick the events recorded in the video, translates them in transcripts, descriptions and meaningful narrations for the research objectives.

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The hypostheses and their categories

Hypothesis 1 In order to understand the teaching practice it is necessary to take into account the context that supports it. In other words, the material, temporal and spatial dimensions of the practices is where the meanings are built by the subjects and where they express their intentionality. The main problem is a social one because it is related with the relationship and influence with the Others influence while the learning activities are done. In this conception of situational learning, the *structural resources* that give the teacher opportunities and limits become relevant.

H1 The meaning of the activities rely on its position in the sequence of the class guided by the teacher. This position gives context to the construction of "scientific facts", explanations, evidences, the relationship of the practical activities (to experiment, "give examples") with the "more theoretical" activities (search concepts in a book), etc. It implies the distinction and understanding of the relation between the content activities with the work organization and the participation; its sequence, how simultaneity and rhythm influence the easiness or difficulty that the students have while being in the class and how they appropriate the knowledge.

Although the session or class duration varies often, the teachers organize the set of activities in introductory, development and closure parts. This organization is repeated continuously until it forms routines.

Hypothesis 2 The events that take place inside the basic education classrooms during the science class have a relation with the historical and contextual aspects that determine the curricular project and institutional conditions that conform the educational practices.

The teacher pretends to emulate the cases, scientific roles, their procedures and instruments.

Following Shapin and Shaffer (2005) the scientists require a material technology, a literary technology and a social technology. The material technology involved in the construction and operation of the machines so they can reinforce the perception; to constitute the perceptible objects and to produce them intellectually. The literary technology allows socializing the produced phenomena, checking their plausibility parting from the already given knowledge, as well as the credibility and reliance that offers to the witnesses; which allows to put an end to the controversies and generate accords. The social technology incorporates the proper linguistic practices and conventions. Shapin and Shaffer (2005: 44) consider "the scientific method as a crystalized form of social organization and as a mean to regulate the social interaction inside the scientific community." In this sense the school imitates and applies this technology to validate and legitimate the knowledge, as well as to grant; for example, the compatibility between empirical data, evidences and facts that conform the discussion and concepts in the free text book (in Mexico the basic education students get for free a set of books whose contents correspond to the mandatory curriculum).

H2 The social becomes content. The process of knowledge construction, even in natural sciences subjects and in the experimental activities with and expected "objectivity" in the procedure, implies a negotiation of the meanings and the modification of the sociocultural context, as it generates the conditions that benefit or obstruct the learning. The objective materiality, time and space interact with the subjective ones.

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The teachers mediate and represent the academic and the normative, and in this case "the scientific". The students require time and experience to understand the dynamic, and to be able to participate corporally and discursively in it.

Several authors have studied the relation of the social with the cognitive and the linguistic; especially how the basic education students interpret the contextualization keys to answer the questions made by their professors in science classes. Considering this we have to hold as true Lemke's affirmation that to master a subject, as specialized as science, means to master its specialized forms of language use (Candela, 1997, p. 37).

(…) kids cannot learn science only from the perceptive experience, but they also have to learn how to describe the experience in the scientific discourse, stressing the school scientific discourse (…) Not only they have to learn how to talk but also how to participate in the social organization of the academic task in the classroom: how to take turns, how to ask for the words, how to listen, what to say, how to say it and to whom direct the discourse (Erickson, 1982). (Candela, 1999:40).

The students' social participation appears to impact in the explications and experiences with the phenomena. This relationship is similar to the social and contextual condition in which the Scientifics work. Therefore, this research considers that there are contact points between the things happening in the science classes and the things done by the Scientifics through the translations done between science diffusion and the curricular designers.

Hypothesis 3 The central objective of the Program for International Student Assessment (Programa para la evaluación Internacional de Estudiantes/PISA) is to measure the degree in which the 15 years old students, who also find themselves at the end of the compulsory education, are able to turn to the things they have learned when they encounter new situations in school level as well outside from it. This means it aims at estimating the level of essential abilities and competences required for their full participation in society (INEE, 2008).

PISA's evaluation model is centered in the concept of literacy (aptitude or competence, although in different countries it has been translated as culture, formation, alphabetization or ability). In Mexico this concept has been managed as competence and it is defined as a complex action system that includes the intellectual abilities, the attitudes and other non-cognitive elements, such as motivation and values, acquired and developed by individuals in their life; and indispensable to effectively participate in several different social contexts (INEE, 2008, p. 31).

The definition of Scientific Competence has three dimensions: Processes, Application Areas and Content. The Processes are the "activities that have demonstrate in function of the types of tasks that the students will find in real life" (p.31). They consist in identifying scientific themes, or in other words, to apply the scientific knowledge in a specific situation to explain, describe or interpret the phenomena, predict changes, recognize descriptions, explications and proper predictions. The capacity to use scientific evidence requires interpretation, elaboration and communication of conclusions and the identification of the underlying suppositions, proves and reasoning (INNE, 2008, p. 32). The Processes have six performance levels. But according to INEE's data (2012),

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In Mexico, the distribution finds itself far away from the average present in the OCDE. In Mexico 2% of the students are in the highest levels, while in the OCDE's average 29% of the students are in the same level. In the intermediate levels (2 and 3) Mexico presents 51% of its students, compared to the 54% of the OCDE's average. In the lower levels (1 and Under level 1) the OCDE's average concentrates 18% of the students, a striking difference with the 47% in Mexico. (p.6)

In our country, an evaluation that explains the conditions of these results does not exist yet. Nevertheless, studies about science learning in basic education, especially in elementary school, demonstrate that that the kids need to understand, explain and argue in order to learn (Giordan, 1982; Driver, Guesne y Tiberghien, 1985; González 2007; Candela, 1997, 1999). In addition, the students refuse to accept the knowledge even going against the teacher's affirmations, they discuss their knowledge in a social practice trough the empirical evidence that comes from the class activities as well as their experiences from outside the school in order to convince the others that their version is valid and look for accords. For Jiménez-Aleixandre (2010, p.11) to argue is the capacity to relate explications and proves that "could be defined as the observations, facts, experiments, signs, demonstrations, reasons, as they try to demonstrate that a sentence is true of false" (Jiménez-Aleixandre, 2010, p. 20).

Even with current PISA's results, there are not many studies that specify which actions promote the mentioned processes in the students. Therefore, the hypothesis works in an explanatory level.

H3 In respect to which are the effects of the teaching actions in the production of affirmations, explications and arguments in the students.

Hypothesis 4 The actions developed by the teacher have their basis in their formation, initial and permanent, whose tendencies run in parallel to the educational politics from each period. In the first part of the twentieth century were valid the paidocentrism, the positivism, and the scientific contents were acquired through its "method". In the seventies, the use of the lab emphasized the inductive thinking (López, 2003, p. 378) with Bruner. Also in the seventies, the meaningful learning from Ausubel motivates the necessity of a scientific culture. It is in this period that terms like "scientific alphabetization", "science for everyone" or "science, technology and society" appear (López, 2003, p.379). In the eighties, the debate intuition/systematization of information complements, with authors like Piaget and Vigotsky, the Constructivist propositions with a cognitive turn. These ideas are imply in the current ones, in the recognition of the previous ideas and the conceptual change. These tendencies affect the official curriculum, especially the teaching profile and the reach of the institutions, the traditions and the practices of each school center.

The MEB-RCTS takes into account these tendencies because it looks to form in the field of science teaching, especially with the requirements of the current Basic Education Reform. In the graduate profile (UPN, 2012) the resignification and the transformation of the work in the classroom stand out, as well as planning. It takes into account the specific students' necessities and the school's context, and the revaluation of their role as a fundamental educational agent.

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With the competences, it looks for the reflection on the social importance of the science, the scientific contents that work in the school, and the learning psychological theories that have affected their teaching, the psychopedagogic perspectives for the curricular analysis, to generate the mediation and research tools.

In the MEB-RCTS operation underlay assumptions shared in this research. First, that there are modifications in the practices of the student-teachers' practices. Second, that these modifications are a consequence of their studies in this Master program. Third, these changes "improve" the teaching and learning processes. Fourth, that the experience of the intervention is professionally formative. Therefore, the fourth hypotheses compares the characterization of practice with the teaching exercise that correspond with the expected competences in the MEB-RCTS (UPN, 2010).

H4 In the practice during the intervention teaching actions present themselves and reflect the exercise of the expected competences in the MEB-RCTS.

Results

The results are presented in the next section and use the matrixes from the case of an student-teacher that will be used as codification model (Derry, Pea, Barron, Engle, Erickson, Goldman, Hall, Kochmann, Lemke, Gamoran y Sherin, 2010, p. 21). It is deep-rooted in the disciplined observation that leads to the refinement of the categories and allowing a trustworthy codification of the new characteristics of the phenomenon, where it will be useful to consider, ahead in the research, their quantification.

The case corresponds to a fifth grade group from elementary school by thirty students (As, Ao, Aa) from which sixteen are girls and fourteen boys. The teacher (Ma) has as purpose to recognize the previous ideas that the students have about concepts like environment and responsible consumption, to formulate a problem and to do an intervention afterwards. The expected learning in the official program is to argue the importance of the responsible consumption given the environmental implications of the satisfaction of the human necessities.

Co-construction of curricular content of Biology, Physics or Chemistry

A transcription of the dialogue of the teacher and the students. The following colors are marks of the type of activity: Content, Organization of teaching tasks, and Organization of the participation. Then the fragments are put together and codified. In respect with the space and time, a description of the stage and a narration of the things that happened to give a full depiction of the situation are done.

MATRIX TO OBSERVE ACTIVITIES AND THEIR CONTEXT	
Indicators	Obtained codification
Types of Activities 1) Contained	As: Enumeration of actions and examples. Ma : Closing sequences with short definitions
2) Tasks	It is clear the sequence of tasks.
3) Participation	They are clear rules of individual participation, team and group .
Routines	Question and Answer, enumeration, sequence of activities .
Interruptions	Murmullan when a subject seems funny.
Uso del *espacio-tiempo*	Furniture organized by teams, teacher leads class control from the front of classroom.

Figure 1

In this case, Content activities cover the development in three concepts: environment, consumption and responsibility. The definition of environment mentions the objects that it contains; the students mention: nature, animals, plants, ecosystems, trees, grass, and water. The teacher includes humans and everything that is around us; she affirms, "Everywhere there is environment" establishing in a relationship of equality the container and the contained.

The definition of Consumption consists in the actions that the students mention: throw away the garbage, eat food, and take water, "the consumption of everything we need". From the last affirmation the teacher asks what else do they need. The students make a list: air, oxygen, sun, water, food, light, plants. The teacher questions if we consume plants and a student says "spinach". The teacher questions where do we consume energy. The students confuse the energy consumption as food and as the energy used to cook. A student proposes that there is also an energy consumption when they eat, although neither he nor his classmates explain these affirmations furthermore.

In respect with the types of consumption besides eating, the students combine actions and objects of consumption: the animals and plants consume water, energy and electricity. The teacher leads de dialogue to the other actions besides eating: breathing, resting. The teacher asks where this happens; the students mention the bed and the couch. Then she asks if they eat themselves (uses an absurd) to affirm afterwards, "Consumption is not only to ingest". They keep enumerating studying, light, water, lunch, colors, cases, tables, notebooks, chairs, clothes, uniforms, glasses, pull over, shoes, T-shirts, water television, internet that "cannot miss"; bathroom, pet, and the teacher complements "to make you company", "everything is a part".

With responsibilities, they work too with the enumeration of actions: to bring homework, make the bed, take care of a pet, fold the clothes, and wash the dishes. The teacher defines responsibility with other word "obligation"; a student says "duty". The teacher asks for expressions that have the meaning "this person is responsible". The students say to do their duties, compromised, to do the things by themselves, "to be conscious of the consequences". The teacher relates consumption and complements "sometimes we buy thing but we are not conscious". Then she enlists the causes: taste, necessity, mode, fun, "is attractive to us", "is our favorite toy", and "we have lots of fun".

The teacher asks them to define responsible consumption: to eat well, "is what we really need". The teacher questions again "Then, do you buy what you really need?" "Do you think it is important to consume responsibly?" The students say no and give examples, "we could end with a species". Then the students make a new list: chicken, lamb, coat, shrimp, rabbit, and deer. The teacher asks about the "animals that should not be consumed": deer, a girl affirms "I have tried it already", the children keep mentioning the animals that consider repulsive instead of those that are in risk of extinction: rat, spider, cow, scorpion, and cockroach. A student gives a pertinent example, "Whales, because, for example, in Japan they eat them", "no, in China". Nevertheless, other students keep saying those animals that they find repulsive: snakes, insects. The teacher tries to focus them in the question:

Ma: Well, and which animal do you think is in danger of extinction and we should not eat it, no matter the case, and neither have it as a pet because it is also there. Right?

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The students answer: shark, bear, panda, turtle, wolf, porpoise, polar bear, and hedgehog. The teacher changes the example to the energy consumption to come to school: car, bus, taxi, public transportation. The teacher asks them to define the actions needed to take in order to have a responsible consumption, "Ways to consume for not consuming too much". The students enlist actions: fill bottles with water, open the blind and turn off the lights, bring their own lunch. A student mentions reuse, and the teacher ask which are the Three R's, recycle, reuse and reduce. Teacher questions if "They can be done?" and clarifies that "to recycle requires another process". She also questions why people buys products. The students answer: taste and reward. The teacher asks, "What do the people do so I buy things?" to which the students respond: poster, slogans, famous people appear, someone attractive. The teacher asks what does the text in the back of a junk food product say as she shows it. The students answer: ingredients, nutritional information, calories, to know what is in it, quantities, and if it is nutritious. Finally, she asks for the problems it can cause and the students respond: cardiac problems and diabetes.

In regard with the Organization of the teaching tasks, the class lasts 50 minutes in the videotape, from which the first 18 were dedicated to work with the concepts. From minute 19 to 39, the group, organized in different teams, made an anti-advertisement poster. From minute 40 onwards the teams exhibited their posters to the rest of the group.

The questions done by the teacher are complementary. She writes on the board so the student can infer the answer that, mostly, is a single word. She works with the three concepts and the same routine. She points out when she needs one single student to answer or the whole group, rising their hands to take turns for speaking.

The teacher repeats what the students say. When she considers a question is incorrect, she asks the other ones if they agree. The students answer with negations or take as granted that an alternative answer is needed. When the teacher considers that the concept has been already defined ends the questions and answers' sequence and makes a different question or gives a short definition. In less occasions is the student who gives a short definition. The group forms four teams according to their affinities and the teacher gives them a product so they can do an anti-advertisement poster. The students ask if they are doing it well.

On the other hand, with Organization of the participation, the teacher brings a guide to the class and focus the children's attention to the front of the classroom through questions, she supervises the work in teams, and when she asks a student to respond, she does it insistently. For the direct calls of attention, she requests that the students rise their hands and she asks twice that they remain silent when they start talking and interrupting each other. The pronunciation error in "dishes" is taken as a joke, as well as "your cousins' the pigs". Although the teacher is not the permanent teacher, she was trustworthy enough to encourage an active participation, the group looks well integrated and they are respectful with each other.

It is notable that the teacher encourages the co-construction (Rockwell, 2000, p. 20) of the concepts when she boosts the students' interaction with her and with each other. They mediate the definitions verbally, as well as their written representation, the use their local, personal, and school knowledge. They transform the definitions and apply those definitions in several examples.

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Social, literary and material Technology.

In the transcription, the use of materials and the combination of technologies are color marked, extracted and poured into the matrix.

MATRIX TO OBSERVE OBJECTS AND REPRESENTATIONS Indicators Obtained Coding	
Translation	Teacher combines verbal language, gestures and writing on the blackboard. Students answer questions with short answers, equipment and build a poster exhibit.
Objects	Blackboard, leaves held together with tape, bags of junk products and markers, written symbols, simple enumerations, few complex ideas.
Representation	Poster with an anti-advertisement that describes true characteristics of product.

Figure 2

The teacher asks and writes on the board while, with her voice intonation and her gestures, cheers her students to participate. She relates the students' previous knowledges with the concepts through the objects and actions enumeration, and close the ideas with short phrases. These lists of objects and actions depict systemized data but few logical relations of inclusion within these elements existed.

The teacher repeats the things said by the students sometimes with a question tone. The teacher repeats the complete answers that are the most complete and make a closure of the ideas. Sometimes the teacher changes the sense using a negative form and takes as given that the whole group understands it. Although the ideas are complete, they are not concepts, they do not look to do a system and they do not look either to contradictions within them.

Instructional framework of scientific competences

This research takes for base the instructional frame of McNeill and Krajcik (2012) to evaluate the scientific explanations.

Variations of Instruccional Frame for Scientific Explanation (McNeill and Krajcik, 2012, P. 35) (Fragment)	
Complex Level	Variation 4 1. Affirmation -a statement that answers the question 2. Evidence -data scientific evidence supporting -data need to be appropriate -data need to be sufficient 3. Reasoning Multiple components -a justification why the evidence supports the claim using scientific principles Each piece of evidence may have a different justification why it supports the claim 4. Rebuttal -describes alternative explanations, and provides evidence and inconsistent reasoning why the alternative explanation is not appropriate

Figure 3

The research found the teacher's questions made during the class. Some questions are rhetorical and use them as a mean to maintain the students' attention and for them to give alternative questions (or correct ones). With others, the aim is that the students think about the things they say (for example if the humans are part of the environment).

The teacher mentions most of the closure ideas; the students mention some:

Aa: It is important because sometime those things that we don't need end up in the garbage and there are some children that cannot buy them and we are wasting them.

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Ma: Exactly

Aa: And we don't use it

Ao: Because, for example, if we are not responsible of the things we eat, right now, I'm speaking about animal consumption, then we could end with a species.

There are questions that are not complete (the children explain and argue), for example when the girl mentions the deer as an animal consumption. The children mention animals that usually are not a part of the daily diet because they consider them dangerous or repulsive. The students do not appear to understand the ethical sense that the teacher is looking for.

There are affirmations with a complex logical structure that are not clear (oil consumption as energy, or to cook the food and the food to produce energy in the body). Other examples are:

Ma: What pollutes the most, your car or the public transportation?

Ao: Both of them, both of them

Ma: With both of them. However, what is the difference with the public transportation and your own car?

Ao: In public transportation, you, you pay.

Aa: Sometimes, but there is always more people (the idea more people can use the public transportation)

Ao1: Well the candies say, in the ingredients, that they have artificial colorants and this can be harmful for you.

Ao2: I say that the candies are tasty but when you start to analyze properly the nutrimental information, you are not going to think the same as when you bought them just for pleasure or because you liked them.

Ma: Do you recommend them or don't you, Team 1?

Aos: Noo, well, only once in a while.

Ao1: Well it is not recommendable to eat them every day. We advise to eat them, for example, one day each month or something like that, but not so often.

Ao2: Once per month or per week because if you eat them every day you can get sick.

Although the teacher promotes that the students justify their questions, these are enumerations of "causes" or "variables", which do not relate one with the other, developed through examples. This could integrate explications partially, but not argumentations.

Teacher responses to the conditions of school environment

This research uses a matrix based in the curriculum or competences' list from the MEB-RCTS. In respect with the Didactical Competences, the observation is that the teacher plans her activities ahead and orientates the students towards the already set contents so it does not lose the objective and get to the intended point.

She also gives instructions clearly for the activities to be done by the students, has a good group control, which allows her to complete the class as she had planned it, but it is not clear if she handles the Environmental contents theoretically because she does not get into details. The emphasis in the intervention done by the teacher lays in her invitation to the students to say everything they know and to apply it to an authentic problem.

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The teacher keeps a friendly and trustworthy communication with the students. She respects their opinions and invites them to keep participating; the vocabulary she uses with them is the proper one for their age and context. Even though she is not the permanent teacher, the students know the code she uses, like rising their hands to take turns and to do what she asks for.

Regarding the MEB's Competences, the teacher showed leadership, oral and written expression abilities. She retrieved everyday knowledge, psychosocial and affective aspects. She also planned taking into account the specific necessities of her students and the school's context. She uses the resources within her reach, includes everyone in the activities and promotes collaborative working. The sense of the school's work responds to already known routines.

In concern with the RCTS's Competences, the teacher plans and implements an educational intervention in the classroom. She applies partially the processes that characterize the sciences and their research methods (explanation, variables and argumentation). Although she aims at arriving to clear definitions, she did not contrast the scientific contents at the school with the definitions. She considers the possibilities of the school's context and the students' specific necessities, and interprets ordinary situations partially in a scientific way.

She also recognizes the importance of the everyday knowledge for the construction process; nevertheless, those notions are not structured logically in concepts, as well as complete and pertinent models.

Conclusions

The development of the research instruments, in this case the matrixes for the videotaped observation of the teacher's practice during the intervention process, allows obtaining qualitative information about the qualitative characteristics of this professional practice. These characteristics are comparable to those stated in the graduation profile, the evaluation of their knowledge, their written thesis and their opinions. The triangulation involves their limits, because the formation has mediate effects and therefore, it would be necessary to do a longitudinal follow up with the next generations. In the other hand, the continuous changes in the educational reform have to be taken into account, as well as the graduation profiles, especially because the intervention's methodology implies an identity with the student-professor and the researcher and mediator.

The use of matrixes by the researchers in collaboration with the students (auto-observation) help to make visible the best practices, the agency of the actors when they face the problems and focusing in authentic problems, in the sense that they overcome prefabricated, linear or exclusively evaluative models, which contribute little to the satisfaction of the educators and their beneficiaries' necessities. It has a relation with the distinction between short-term goals (for example the appropriation and application of the scientific concept) and the long-term goals (like the processes of argumentation and formation of scientific attitudes, which also can be transversal).

It also has a relation with the knowledge from the student-teacher with the capacities and abilities that the students have and the superior level intended to reach.

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This research agrees with Engeström (2011, p. 602) in the proposition that the theoretical problem that underlays in the intervention is one of causality, because it needs a methodological and ethical vigilance over the agency's empowerment process. It requires the whole research team to do a critical work (8 members) and not only the application of the observation protocols. It requires sensibility and respect, since the actors trust in the person that is watching them, and it must be clear that the intention of the observation is to understand the things that are happening in order to know, and codify the phenomenon and build the proper instruments. The search for an individual deficit and an efficient rationality are not the goals.

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Power factor correction for the efficient use of electrical energy, a success case at Universidad Tecnológica Emiliano Zapata del Estado de Morelos

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Abstract

Fruits and vegetables are normally presented to consumers in batches. The homogeneity and appearance of these have significant effect on consumer decision. For this reason, the presentation of agricultural produce is manipulated at various stages from the field to the final consumer and is generally oriented towards the cleaning of the product and sorting by homogeneous categories.

The aim of this paper is to present the technique classification of oranges by vision, and to evaluate the efficiency of this technique regarding the color like quality attribute for detection of external blemishes. The segmentation procedure used, based on a Bayesian analysis, allowed to classify fruits according to their colors. The results obtained show that the quality of images to be analyzed has a great influence on the decision of the system. Blurred image increases the error of confusion in the classification, because the system will not be able to differentiate the color of good oranges with those that are rotten. For this reason it is very important to use a good quality camera providing images.

Bayesian classification, image processing, quality of fruit, segmentation

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Introduction

Energy is that human beign use to have hot where is cold, do activities in an easy way, and to have ligth where is darkness for example. But having this energy available has a cost, some energy hs to be inverted to get the one human beign are going to use: gasoline, gas or electrical eneergy. This energy costs to the society and to the Earth planet, is why the sustanaible concept has a very important place in these days. Therefore, two issues are intimately related about social impact in the energy field: the competitiveness of the economy and the climate change.

Electrical Energy has transformeed the way human beigns live their lifes. The majoriety of human's beings activities, in urban communities are based on the use of electrical energy. The power energy commonly called as electricity, that human beign use at houses, building offices, and so on, is named in electrical engineering field as alternating current. Nikola Tesla was the electrical engineer who invented, or maybe discovered, this kind of current (Burgan, 2009). Actually Tesla faced a real war against in early 1880s, against Thomas Edison, both were embroiled in an epic battle now know as the War of the Currents (Burgan, 2009) (Smithsonian, 2015). Nikola Tesla fought for alternating current, (AC) and Thomas Edison for direct current (DC), and Tesla won the battle, sponsored by Geroge Westinghouse. Therefore the power energy people use at home, work, entertainment centers, and so on is Alternating Current (AC). Definitely the world would not be, as we know it today without the important contribution of Tesla, since the use of alternating current enables more efficient distribution of energy, from where it is generated to where it is consumed.

This would not be possible if DC is used instead of AC. Nevertheless conducting the energy from is generated to where is going to be used, implies a lot of interesting issue to have into account, and to deal with them.

There are a lot of losses in the complete process: generation, transmission, distribution and use, hence a managment energy procedure must be implemented in each one of them. The last one depends on the users, the other three to the energy company. Users are people to demand power energy to develop their activities related to work, home and entertainment. Under this specific scenario, losses or not an efficient use of energy is related to, Fig. 1.

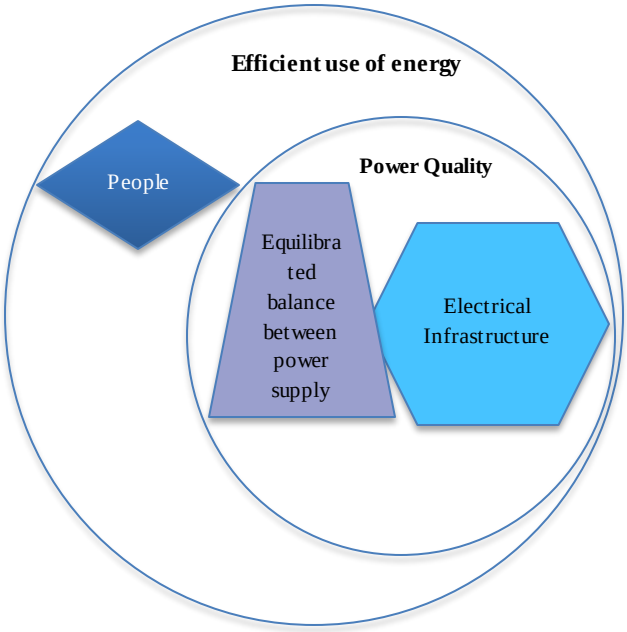

Figure 1 Factors about efficient use of electrical energy, from the users side

Is important to puntualize that there is a significant difference between energy saving and the efficient use of anergy (EUE), even tough they are intimately related. Efficient use of energy is one of the causes for saving energy is the consequence.

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In any kind of institutions implementing an energy management system in order to use electrical power efficiently, producing economic, social and environmental impact it is needed.

According to the National Commission for the efficient use of energy (CONUEE, acronym in Spanish), an energy management system is: "a methodology to achieve sustained and continuous improvement of energy performance in organizations in a cost effective manner" (CONUEE, 2012). Emphasising that the main factors of change are: operational control, adjusting controls, training and sensibliización, the same as have been mentioned in Fig. 1.

here is also the IEEE 739 – 1995 Standard:"IEEE recommended Practice for Energy Management in Industrial and Commercial Facilities" (Standards, 1995). Its purpose is to provide an engineering guide both for energy conservation and for use in electrical design. "The purpose of this recommended practice continues to be one of providing a standard design practice to assist engineers in evaluating electrical options from an energy standpoint. Hence, it is a recommended practice for energy management in design and operation of an electrical system" (Standards, 1995).

The essence of power quality, Fig 1., is the ability to accept power from the distribution bus for ultimate utilization, compatible with characteristics of loads. In commercial or industrial applications, this may involve a process that might entail a dynamic relationship to the AC voltage supply. AC voltage has the form of a sinoidal wave, Fig. 2.

However there are a lot of issues related with different topics that could or actually make distortions on this waverform.

Distortions in the waveform are a special issue to study and have direct and significative impact about the power quality (Cáceres, 2008). It is reported at the literature about experimental and analytics studies about the effect of the waveform distortions of voltage and current over the elements of the electrical grid (Situations, 1996) (Cáceres, 2008). Some of the factors that generate distortions are the electronic power equipments.

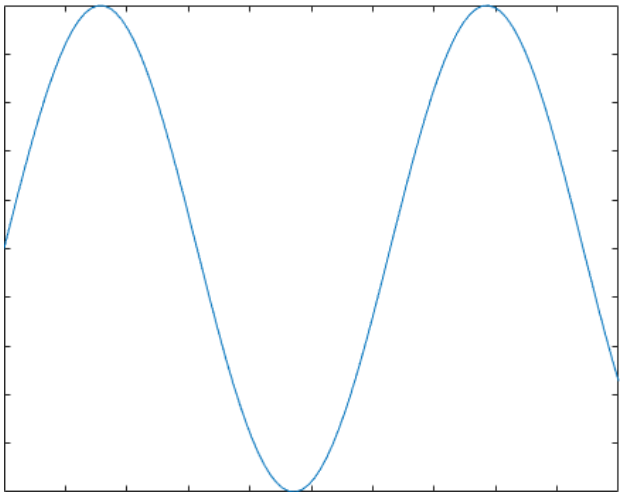

Figure 2 AC voltage and current waveform

It has been shown that they modify the sinusoidal nature of power electric signals. They cause an inefficient use of electrical energy; because they cause resonance problems, over voltage, the increase in losses due to they increase the distortion of current waveform (Magnago, Reineri, & Santiago, 2011; Magnago, Reineri, & Santiago, 2011). Between them employing power electronics, they merit special study, those with "socket" on a small part of the cycle of tension as the lamps called low consumption and those employing switched sources. This distortion could be provoked for an angle difference between voltage and current, since it produces power oscillation between the source and the load.

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One of the parameters to have an idea that how ideal is the interaction between power supply, internal grid and balance loads, distortions (called armonics) is the power factor (PF). PF is defined as the coefficient of active power suministred to the load (P), and the apparent power (S) (Fink & Beaty, 2013).

$$PF = \frac{P}{S} = \frac{V_0 I_0 + \sum_1^n V_n I_n cos\,\varphi_n}{\sqrt{\sum_1^n V_n^2}\sqrt{\sum_1^n I_n^2}} \quad (1)$$

In general parameters used in electrical analisys are defined for sinusoidal conditions, therefore equation 1 most frequently is approximated to:

$$PF = \frac{P}{S} = \cos(\varphi) \quad (2)$$

However is important to keep in mind and not dispase distortions to have a clearer picture of the electrical behavior (Cáceres, 2008). Since this work is about the initial analisys of the PF in the electrical grid of Universidad Tecnológica Emiliano Zapata del Estado de Morelos (UTEZ), and was based on the information on electrical parameters provided by the Federal Electricity Commission, both the receipt and the website. PF is interpreted as interpreted as measurement of performance power transmission, since it relates the usable power P with which it is necessary to provide S.

Under non-sinusoidal waveform some parameters could be misinterpreted, and some others can have no meaning at all. The most affected electrical parameters are apparent (S) and reactive power (Q), Fig. 3. P is what is the one used to be transformed into different types of energy, it is measured in W, represents the average value of the instantaneous power of a fixed period of time. Q is related with reactive loads in an electrical circuit in general.

It is supposed that them do not dissipate power, but they draw current and drop voltage, so they actually dissipate power in a certain way. Its measurement units are named Volt-Ampere-Reactive (VAR). Due to its reactive nature, Q can be compensated with inductive or capacitive devices.

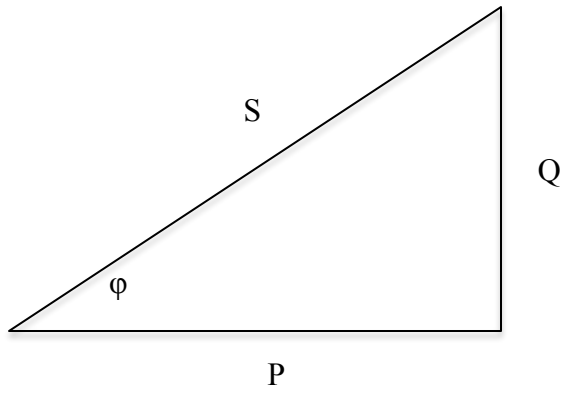

Figure 3 Mathematical relationships between different kinds of power

The mathematic expression for instant power of pure sinusoidal waveform is (Magnago, Reineri, & Santiago, 2011):

$$p(t) = Pcos[1 - \cos(2\omega t)] + Qsin(2\omega t) \quad (3)$$

Where ω is the angular frequency, measured in radians. P is kown as the mean value of p(t):

$$P = VI\ cos(\varphi) \quad (4)$$

And reactive power:

$$Q = VI\ sin(\varphi) \quad (5)$$

The ideal value of Q is zero, because it means PF is equal to one. For example Q is the voltage drop in transmission lines. S is the geometric sum of Q and P, its measurement units are Volt-Ampere (VA). All of these defintions and mathematical equations are for sinusoidal signals. However not always they are sinusoidal, distortion has an important role.

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Values of PF close to 1, means there is a grid (source, transmission lines and loads) with quality, and the electrical energy is used in an efficient way. If PF tends to be one, this means that:

- Angle φ tends to zero.
- P and S powers are equal.
- Q tends to zero.

Even though power traditional power definitions are well described at the litherature and well known, just the active power concept has a clear physical meaning even for non-sinusoidal conditions. The other ones could be misunderstanding or intrepeted based on their mathematical formulation.

Hypothesis 1. Non-sinusoidal behavior of the electrical grid could provoke a not straight forward between power factor and reactive power.

Hypothesis 2. PF close to one is possible, even tough there are no inductive or capacitive devices installed to reduce reactive power.

People factor, is related with the culture, the habits, the way people adopted in a consciousness way the importance to use all resources in general in a moderated manner. Information Technologies (IT) are useful tools to divulgate information related with any topic to implement. IT can be used to develop a solid information structure in order to implement the culture of EUE:

- Videos (UTEZ, Universidad Tecnológica Emiliano Zapata del Estado de Morelos, 2015), (UTEZ D. , 2015).
- Applications for mobile devices (Del Pilar, Salinas, Velázquez, & Adan, 2015).
- Web page (UTEZ, Universidad Tecnológica Emiliano Zapata del Estado de Morelos, 2015).
- Electronic tools to calculate consume levels.

According with data reported by the New Buildings Institute, they indicates that plugs loads could be representing more than 50% of the electrical energy used in buildings with high efficiency systems (Menezes, Cripps, Buswell, & J. Wright, 2014). It is why is necessary to implement different mechanism to sow the culture of EUE in people, because they are the end users of electrical energy. For example, one survey revealed that less energy is consumed out-during working hours (44 %) than out-of-hours (56 %) (Masoso & L.J, 2010), because some people left equipment and lighting on at the end of day.

Methodology

The methodology was simple: basic and available data analisys, visual inspection, house keeping to electrical facilities.

Basic of avalilable data

As a first step the payment receipt sent by the Federal Electricity Commission (CFE its acronym in Spanish) analyzed this as a research initiative rather than an institutional instruction. In the UTEZ, sustainable campus program implemented since 2012, and one of the axes of this is the theme of efficient use of electricity.

Following the research methodology suggested by Sampieri (Hernández, Fernández, & Baptista, 2006), one could say that the research question was: How is energy consumption on the campus of the UTEZ? To that based on these lines of work they were defined on how good or bad it was. There is some interesting and usefull information on the CFE payment receipt, Fig. 4., one of them is the PF.

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Other information is related to the type of rate, demand contracted, the connected load, the kilo-watt hours (kWh) consumed in different hourly rates. Besides technical information, economic information is showed; one of them is straight forward related with the PF, one called bonus. This bonus is applied to the institution if PF is equal or greater than 0.9, on the contrary if the PF is below of 0.9 an economic penalty applies. According to CFE PF is an indicator on the correct use of energy, is generally the amount of energy that has become work, which is in agreement with the description wrote above. According with this definition if PF is close to 1, it means all electrical energy consumed by the equipments has been converted in work.

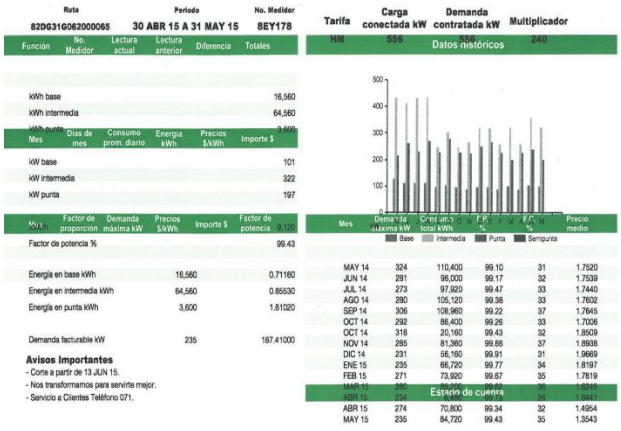

Figure 4 View of part of CFE payment receipt

CFE calculates the bonus or penalization based on:

$$Bonus = \frac{1}{4}\left[1 - \frac{90}{PF}\right] * 100 \qquad (6)$$

$$Penalization = \frac{3}{5}\left[\frac{90}{PF} - 1\right] * 100 \qquad (7)$$

Equation (6) has a maximum applicable of 2.5 % of the total amount and equation (7) has 120 %.

So talking about money it is important to watch very close the PF, to have every month bonus instead of penalization. But also about technical point of view, because low PF means non-ideal behaviour of the grid and instituction electrical grid could be facing problems like premature wear conductors, increased losses in conductors, overloading in transformes, higher power consumption, and distribution lines and increased brownouts.

Analysis of historic behaviour of electrical powers

The second step as part of data collection, contacted the FIDE (acronym in Spanish Trust for Electric Energy Saving), and the password was obtained to enter the website where the database historical of all electrical parameters and economic (Electricidad, 2010). And getting historical data, a variable behaviour of PF was found, Fig. 5.

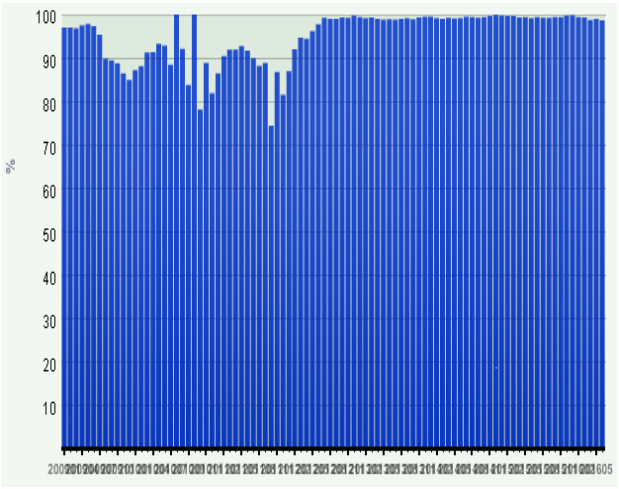

Figure 5 PF behaviour timeline

There is very clear variation on PF behaviour through the time. Before research was started the PF was variable, impredectible and lower than 90 %. There are two populations in the PF timeline, one before the variation and other after that, what can be observed better in a histogram graph, Fig. 6.

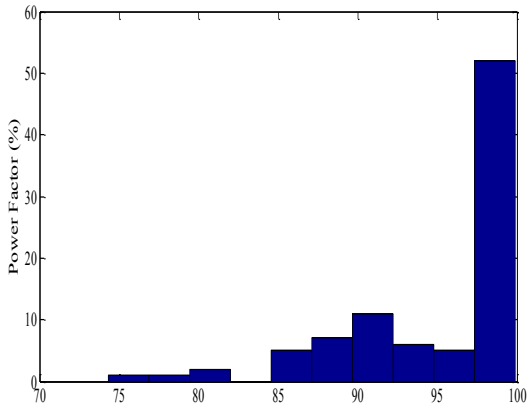

Figure 6 Two populations of PF data

Analizing Active (P) and Reactive (Q) powers, a different behaviour can be found, Fig. 7. Data distribution for P (kWh) has a more normal behaviour than Q (kVARh), Fig. 7. It means, in principle, that Q has a more variant and non controlled behaviour than P, and therefore S behaves in the same way, since Q, P and S are geometric related, Fig. 3:

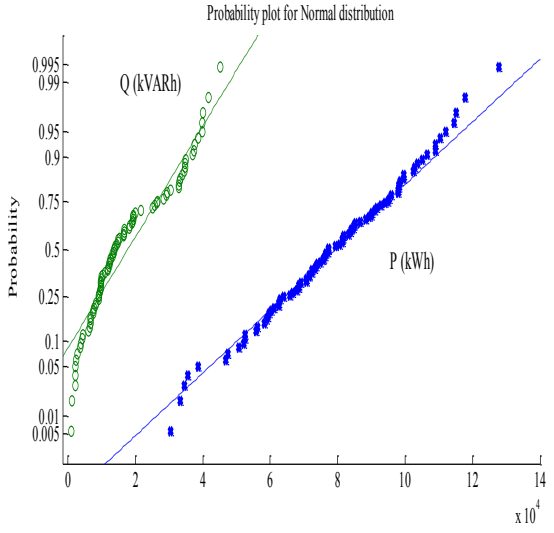

Figure 7 Normal distribution test for P and Q

$$S = \sqrt{P^2 + Q^2} \qquad (8)$$

A correlation analisys between PF and P and Q was performed, Fig 8.

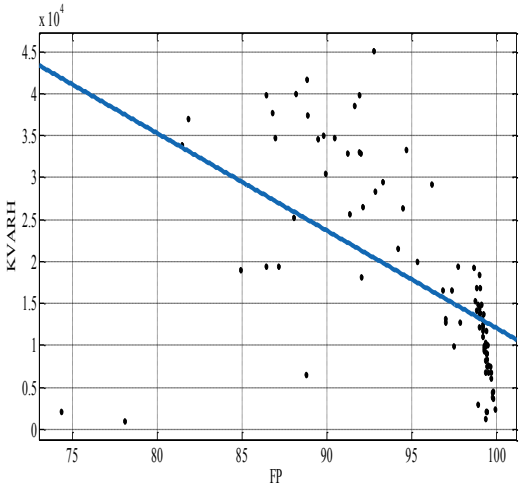

Figure 8 The higher the Q the lower the P

According with the graph Q vs P, a clear correlation can be stablished observing just the line, however due to the data dispertion the r-squared value is low, 0.3029. It means the linear model for the correlation analisys adjust poor for Q data. In the case of P vs. PF the r-squared is 0.1848, therefore statistically most significant dependency observed of PF from Q.

Visual inspection and house keeping

Next step was the visual inspection to the electrical facilities, focussed on electrical substations and ground systems.

About substations, was found some anomalies like high humidity, corrosion, insulators and damaged pipelines, mud, water, pipelines capless, Fig 9.

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Figure 9 Damage in the electrical substations

Not just the corrective maintenance was performed but a redesign of the substation ventilation systems, drain added, was waterproofed, the ducts were fixed in a dry space, and grounded to prevent the passage and accumulation of water was added area.

About ground systems, if they existed but had not been given since the buildings maintenance, 10 or 15 years ago they were built. These systems were identified; it became a mapping of all ground systems campus, and started with redesign maintenance and in some cases, or scheduled.

In general the electrical infrastructure of the university was totally neglected, no inspections, no preventive maintenance, no attention to systems and even ground-ray.

And this is more than a matter of saving enegía is safety for personnel working in it. This has been corrected slowly, and has been getting favorable results.

One of them is the controlled or stable behaviour of FP after the house keeping work performed on the electrical substations and ground systems, as a start, Fig. 5.

Data distribution and correlation analisys, Fig. 10 was performed after that, r-squared raise to 0.6, however still some points far to the line, but the data dispertion is much closer than before, Fig. 8

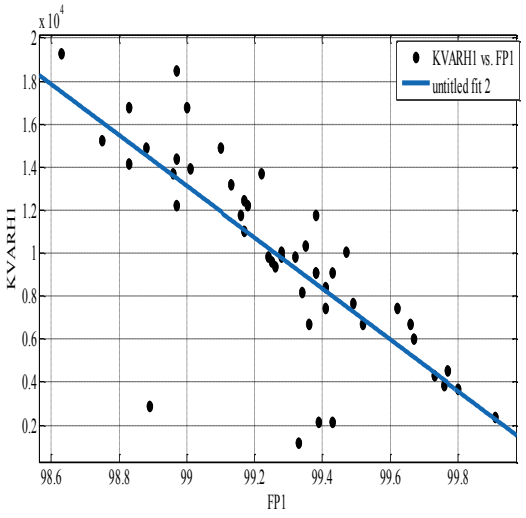

Figure 10 R-squared factor after house keeping

In Figure 11 can be observed that data distribution for Q is more normal after house keeping. Corrections for PF variable behaviour was performed at level of corrective maintenance of electrical facilities into the campus, installation of inductive or capacitive devices was not necessary so far.

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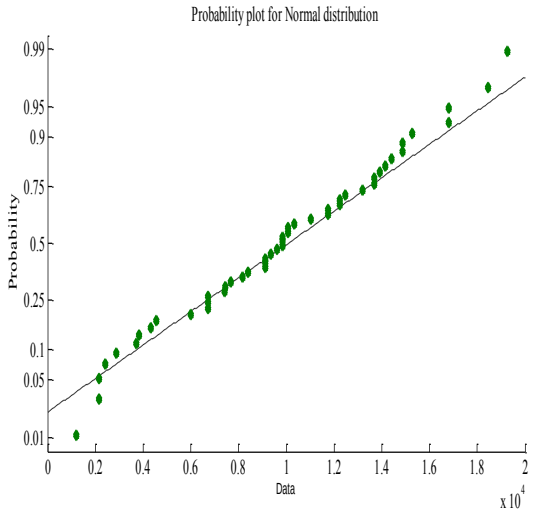

Figure 11 Normal distribution for Q after housekeeping

Results

The variation of the power factor was corrected significantly. It was possible to eliminate this unpredictable variation of this indicator parameter power quality. Corrective maintenance performed to ground systems and power substations had the desired impact. This success allowed a monitoring strategy programmed electrical infrastructure and a preventive maintenance program be designed.

After the previous analisys about public data of energy consumption into the campus, and a visual review of some facilities, a plan to go up the power factor was developed, oriented mainly to sistematize the maintenance of specific electrical facilities, like substations and ground systems.

It is necessary to supplement the analysis and actions implemented with technically formal, systematic measurement of the quality energy on campus, which includes harmonic measurement, measurement of the sinusoidal form of the power output, load balancing, consumption per building, etc.

An important institucional achievement was to have obtained the state prize for energy saving in 2015. This is not only a product of the work on the power factor but the actions were aimed at people in terms of the spread of culture of efficiency, the implementation of change programs luminaries, and technological developments to systematically control the power consumption.

Hypothesis 1. Non-sinusoidal behavior of the electrical grid could provoke a not straight forward between power factor and reactive power. This is the reason why the correlation analysis shows low r-squared values, even after the corrective maintenance.

Hypothesis 2. PF close to one is possible, even tough there are no inductive or capacitive devices installed to reduce reactive power. No one of them are been installed in the campus so far, and the PF has a stable behavior and it is higher than 0.98 level. Some recent energy quality measurements show electric harmonics, Fig. 12, and sinusoidal waveforms distortions, Fig. 13.

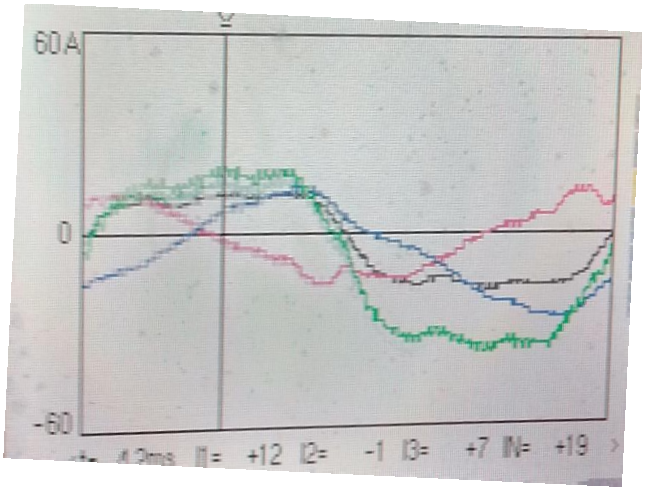

Figure 12 Presence of harmonics in all three electrical phases

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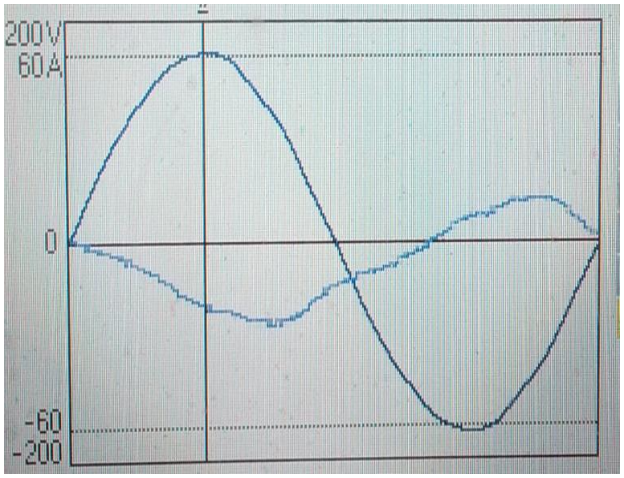

Figure 13 Waveform with some distortion of one fase

Quality energy measurements was not performed before because University has no the equipment, so an external company was hired. Why if there are electrical harmonics in the grid, and institution has no inductive or capacitive devices installed PF is high? There is no answer right now, but this is the future work to be done, to figure out what is happening in the grid.

Conclusions

Pay attention to the electrical parameters that are available on receipt of payment sent by the Federal Electricity Commission (CFE), it is an important starting point for an analysis to understand primary concepts of power quality, both in the process of delivery by CFE and consumption on campus.

Keep the power factor below 0.95, guaranteed to have a economical bonus by the federal electricity company (CFE), but does not guarantee a low level of reactive power, which in principle represent power quality.

Sometimes simple actions affect significant progress in achieving the objectives: schedule preventive maintenance of electrical installations, review of control systems for switching on and off of lamps, program requisitions improvement or repair of control systems on and off of the lights or air conditioners.

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Article
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Optimization of the enzymatic hydrolysis process using bagasse of delimited sweet sorghum

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Abstract

The aim of this research was to optimize the process of enzymatic hydrolysis from sweet sorghum bagasse, maximizing the production of fermentable sugars present (glucose and xylose). The bagasse was ground, crushed and dried, once free of moisture was subjected to an alkaline treatment using 4% H2O2 on a liquid-solid ratio of 16:1. To optimize the enzymatic process a Box Behnken experimental design were used, using two enzymes (hemicellulase and cellulase) and considering three independent variables (time, enzyme % w/w and liquid-solid ratio), being the g/L of xylose and glucose the response variable. A statistical analysis allowed us to determine that the best conditions are: 5 % w/w cellulase, 3 % w/w hemicellulase, reaction time of 48 hours and a liquid-solid ratio of 5:1 generating 121.12 g/L of glucose and 76.38 g/L of xylose. In this investigation is observed an excellent performance of both enzymes working simultaneously, assuring high levels of sugars from sweet sorghum bagasse and discarding the prolonged reaction times because the increase of sugars (glucose and xylose) between the 52 and the 92 hours of reaction is inferior to 14 %

Hydrolysis, sweet sorghum bagasse, hemicellulase, cellulas, optimization

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Introduction

The prospects of depletion of fossil fuels coupled with the growing demand for energy, place liquid biofuels as a renewable energy alternative, within the framework of the growing valuation of fuels that have low impact on the emission of greenhouse gases. Today, however, the damage caused to the planet by emissions from the mass consumption of petroleum-derived fuels, such as gasoline and diesel, in transportation vehicles is increasingly evident (Cardona, 2009).

Bioethanol accounts for about 90% of biofuel produced worldwide. The production of ethanol from renewable sources of environmentally friendly raw materials, such as agricultural crops, forest crop residues, and / or industrial and municipal waste, is currently of great interest. Emphasis is also placed on those that do not compete with their use as a food source, in addition to focusing on the waste of the crop not on the plant as such, that is, on the use of lignocellulosic biomass capable of To generate sugars that can be obtained by the appropriate physical and chemical treatments (Bueno et al., 2009).

Currently, one of the raw materials that is taking a major boom in the production of ethanol is sweet sorghum, defined as a promising crop because of its large biomass production and minimum general requirements (Medina et al., 2011). Sweet sorghum (Sorghum bicolor L. Moench) ertenece to the family of grasses, crop is well suited to growing in warm arid or semi - arid areas. Tolerates heat, salt, and floods. It is treated as an annual plant, although it is perennial herb and in the tropics can be harvested several times a year; has an approximate height of 1 to 3 m depending on the crop (Chuck et al., 2011).

The lignocellulosic biomass of sweet sorghum (bagasse) presents a complex structure, composed of several fractions that must be processed separately to ensure efficient conversion of these materials to ethanol (Montes et al., 2010). The major fraction of the biomass is the cellulose whose glucose chains are grouped in higher structures of great crystallinity, their intimate association with lignin makes their hydrolysis difficult to obtain fermentable sugars (Viñals et al., 2012).

The effect of pretreatment on lignocellulosic materials has been recognized over time. The purpose of pretreatments is to remove lignin and hemicellulose, reduce the crystallinity of the cellulose and increase the porosity of the material. However, an alternative option is only to use a treatment capable of removing the largest quantity of lignin and subsequently providing an enzymatic treatment to the raw material using two enzymes simultaneously, a cellulase and a hemicellulase which must be able to produce two types of sugars Different being glucose and xylose respectively (Agbor et al., 2011).

There are a number of key features for the effective pretreatment of lignocellulosic biomass. The pretreatment process should be of low capital and operational cost and should result in the recovery of most lignocellulosic components in the form of separate fractions, suitable pretreatment will provide favorable conditions for subsequent successful hydrolysis. Hydrolysis literally means decomposition or destruction of a substance, in the case of enzymatic hydrolysis the decomposition is carried out by the use of enzymes. The correct use of the type of enzymes depends on the pretreatments applied to sweet sorghum bagasse (Cuervo et al., 2009).

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The objective of the study was to optimize the process of enzymatic hydrolysis using sweetened bagasse of sweet sorghum, maximizing the yields of two fermentable sugars present, using a hemicellulase to unfold the hemicellulose in xylose and a cellulase to obtain glucose from the cellulose.

Methodology

10 kg of sweet sorghum were ground, producing 5.2 kg of bagasse (BSD), which was sun-dried for 48 h in order to remove most of the water present. After solar drying, a reduction was carried out by means of a cutter composed of 6 blades, in order to reduce the length of the BSD, since a smaller size of the raw material increases the efficiency of the pretreatments applied because there is a Greater contact area (Guarnizo et al., 2009). Finally the moisture of the BSD obtained was determined, before proceeding with the delignification.

BSD delignification was performed by the action of an alkaline pretreatment using H 2 O 2 to 4% in a liquid - solid ratio (RLS) 16: 1 and a pH 11.5 adjusted with NaOH 10 M. The reaction was out for 45 h to finally separate the liquid fraction from the solid, by manual pressing. To the solid sample, 2 washes were run under running water in a 5: 1 RLS in order to remove remaining trace amounts of lignin. We proceeded to a solar drying of 48 h to continue with the next stage of the process.

The delignified BSD must be treated enzymatically, for which it was necessary to determine the enzymatic charges to be used, since hemicellulose and cellulose are still present in different amounts in the BSD. For this, three different tests were performed considering different combinations of cellulase and hemicellulase in% w / w, the concentration of cellulase used being greater because bagasse contains mostly cellulose in its composition.

The enzymes used were Cellic CTec3 and Cellic HTec3 from Novozymes. The preparation of such tests is shown in Table 1, all tests were performed in duplicate.

Proof	Bagasse delignified (g)	Hemicellulose HTec3 (%)	Cellulase CTec3 (%)
1	twenty	3	5
2	twenty	4	5
3	twenty	5	6

Table 1 Preparation of samples with different enzyme concentrations relative% w / w

From the best enzymatic combination found, a Box Behnken experimental design was proposed for the enzymatic step (Table 2). The enzymatic loading in p / p ratio (4, 5 and 6% cellulase and 2, 3 and 4% hemicellulase), RLS (5: 1, 7: 1 and 9: 1) and reaction time (24, 48, and 72 h) and the concentration in g / L of Glucose and xylose quantified by HPLC using a constant stirring of 250 rpm and a temperature of 50 ° C (optimum temperature of both enzymes).

To prepare the samples, was used 0.05 M COONa CH3 initial liquid phase as varying amounts of pretreated bagasse according to different RLS, also the pH was adjusted to 5.0, the optimum working Cellic CTec3 the cellulase enzyme.

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Sample	CTec3: HTec3 (% w / w)	Time (h)	RLS
1	4: 2	24	7: 1
2	6: 4	24	7: 1
3	4: 2	72	7: 1
4	6: 4	72	7: 1
5	4: 2	48	5: 1
6	6: 4	48	5: 1
7	4: 2	48	9: 1
Referring to Fig.	6: 4	48	9: 1
Referring to Fig.	5: 3	24	5: 1
10	5: 3	72	5: 1
eleven	5: 3	24	9: 1
12	5: 3	72	9: 1
13	5: 3	48	7: 1
14	5: 3	48	7: 1
fifteen	5: 3	48	7: 1

Table 2 Box-Behnken design for enzymatic hydrolysis of sorghum bagasse delignification

Inactivation of the enzyme was performed by thermal shock by exposing the samples to 10 min. Baths in boiling water and 10 min in cold water, finally the liquid phase was separated from the solid by centrifugation, the first one was analyzed in the HPLC by introducing each One of the results to the NCSS 2007 software to complete the experimental design and obtain the optimum working conditions of the enzymatic process.

The results provided by the NCSS 2007 Software were validated through experimentation to corroborate the optimal working conditions found, as well as the mathematical model generated.

Results

The results of the percentage composition of the bagasse are shown in Table 3.

Bagazo	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Others (%)
Raw	39.54	29.83	22.21	8.42
Alkaline	50.07	34.56	5.33	10.04

Table 3 Fiber content of sweet sorghum bagasse at different stages

The percentage of lignin removal was calculated after the alkaline pretreatment by equation 1, obtaining a total of 76% of removal, a result superior in 8% compared to that obtained by Viveros et al. (2014).

$$\%\ \mathrm{Rem}_{\mathrm{Lignina}} = \left[\frac{\%\ \mathrm{Lig_i} - \%\ \mathrm{Lig_f}}{\%\ \mathrm{Lig_i}}\right] * 100 \quad (1)$$

Graph 1 shows the results obtained from the 3 different enzymatic combinations of CTec3 and HTec3, where it is possible to observe that in the first (3% HTec3 - 5% w / w CTec3) and the second (4% HTec3 - 5% w / w CTec3) combination, there is only a 6% increase of xylose, while comparing the first with respect to the third combination (5% HTec3 - 6% w / w CTec3) the increase presented is 10.19% of Glucose and 8.75% xylose, however, the latter represents the use of a greater amount of both enzymes, especially in the hemicellulase. Considering that there must be a balance between the economy (cost of reagents) and production (generation of glucose and xylose), it was decided to use the first combination of enzymes, as it was not affected in a drastic production in the hydrolyzation process.

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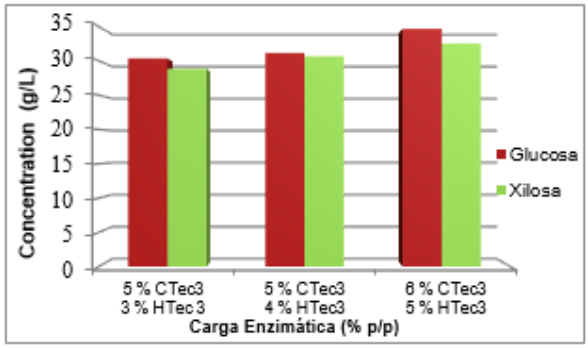

Graphic 1 concentrations of sugars to different enzymatic loads

The glucose concentrations obtained from the experimental design are presented in Table 4, ranging from 81.00 and 135.84 g / L for glucose and 32.17 and 80.49 g / L for xylose, generating the best results in tests 5 and 6, both with a reaction time of 48 h, a RLS of 5: 1, but different enzymatic charges (4-2% and 6-4% of CTec3-HTec3 respectively), which will be adjusted by statistical analysis.

Sample	Glucose (g / L)	Xylose (g / L)
1	98.23	44,463
2	105,324	52,037
3	119,933	65,751
4	104,803	52,484
5	130,259	75.101
6	135,841	80.49
7	95,435	41,088
Referring to Fig.	95,717	43,601
Referring to Fig.	121,557	67,682
10	123,658	68,222
eleven	81.006	36,246
12	92,179	32,171
13	109.856	56,969
14	110,278	57,879
fifteen	108,138	56,912

Table 4 Results obtained from experimental design for obtaining glucose and xylose

The statistical analysis performed using the NCSS 2007 software generated the mathematical model presented in equation 2, representing an adjustment of 93.21% and a theoretical response of 134 g / L of glucose, complying with the optimal conditions of enzymatic loading (CE) Of 5% w / w CTec3 and 3% HTec3, reaction time (t) of 48 hrs and RLS of 5: 1.

$$\text{Glucosa}_{(g/L)} = 15.117 - 31.83 * CE + 2.68 * t + 10.92 * RLS + 3.68 * CE^2 - 0.010 * t^2 - 0.25 * RLS^2 - 0.23 * CE * t + 0.42 * CE * RLS + 0.002 * t * RLS \quad (2)$$

The optimum working conditions (time, RLS and enzyme loading) were tested experimentally. The average concentrations of glucose and xylose obtained are presented in Table 5.

Testing Experimental	Glucose (g / L)	Xylosa (G / L)
General test	121.12	76.38

Table 5 Concentrations of glucose and xylose (g / L) obtained by experimental verification of the optimum conditions optenidas

The response variable statistically analyzed was the concentration of glucose, however a direct relationship was observed with respect to the concentration of xylose generated. Figure 1 shows the response surface obtained from the results generated by the experimental design, combining the effects of time (h) vs. amount of delignified bagasse (g) vs. glucose obtained (g / L), showing the highest Concentration of glucose in the area of intense red color.

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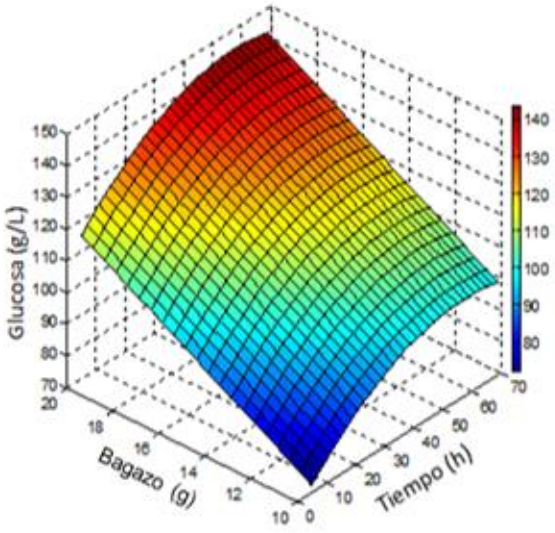

Figure 1 Response Surface glucose content enzymatic hydrolysis Effect Time (h) vs Bagasse (g)

It is observed that the highest glucose generation occurs with an amount of bagasse of 20 g (RLS 5: 1), equivalent to 5 mL / g, besides that after 48 h the glucose increase is minimal, checking the Optimal conditions provided by statistical analysis.

The glucose concentration generated by checking the optimal conditions obtained for the process (121.12 g / L), was 9.63% lower than the theoretical predicted by the model (134 g / L), in addition to generating 76.38 g / L xylose, improving the results obtained by authors such as Chen et al. (2010) and Nochebuena et al. (2012) with 29.84 and 21.01 g / L of xylose respectively by acid prehydrolysis, it is important to note that the adjustment presented by the mathematical model was higher than 90%, which guarantees the reproducibility of the process. The results generated in the design of experiments have a direct relationship between the concentration of glucose and xylose generated so it is not necessary to experiment different ranges in time and RLS for each of the enzymes making the process less complex to take finished.

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Conclusions

Sweet sorghum bagasse can be considered as a bioenergetic crop, when the high levels of sugars contained in it are present, showing concentrations even higher than those of sugarcane and with lower overall requirements.

The application of pretreatment with H 2 O 2 favoreción removing lignin reaching values of up to 76% removal leaving susceptible to bagasse for further enzymatic attack.

The enzymatic hydrolysis was carried out using two different enzymes (Cellic Ctec3 and Cellic HTec3) simultaneously favoring the production of Glucose and Xylose in high concentrations (121.12 and 76.38 g / L respectively), proving that it is not necessary to apply a pretreatment to eliminate the Hemicellulose and demonstrating the good performance of the two enzymes used.

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Self-learning in virtual environments of students of postgraduate students at the Autonomous University of Zacatecas

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Abstract

The research problem detected in online postgraduate students of the Master's Degree in Educational Computer Technology of the Autonomous University of Zacatecas is the "Absence of adequate skills and strategies for the management of their own knowledge in the virtual environment", this study has The purpose of determining the main factors that influence self-learning in virtual environments. For that, an instrument with quantitative variables and a non-parametric analysis was applied based on the Ji2 independence test, with a level of significance and the results affirm that "Self-learning in virtual environments" depends to a greater extent on the "Self-assessment of learning". It is concluded that the promotion of self-assessment of learning with an individual self-diagnosis of the technological skills in the search for information on the Web, such as enabling students to learn to rank their knowledge acquired in such searches, Self-learning in postgraduate students In virtual environments, would consolidate and impact on the quality of online education that is currently offered at the Autonomous University of Zacatecas.

Self-learning, Knowledge management, Virtual education

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Introduction

Self-learning or self-management of knowledge is important in the academic training of students of any level of education, however, as regards on-line modalities, it becomes more important, and undoubtedly one of the most important requirements for a Learning process more efficient.

The present research is focused on analyzing what factors are the most important in this ability that the virtual student should have, specifically what is referred to in the search of academic information on the Web through planning in their searches, the choice of Effective strategies and the self-assessment aspect of the knowledge itself, the above in a pertinent and current scenario, such as the online postgraduate offered through the Master's Degree in Information Technology Education (MTIE) of the Academic Unit of Higher Education (UADS) of the Autonomous University of Zacatecas (UAZ).

The research work is elaborated in five sections which comprise the stages. The first section includes the definition of the research problem, as well as its antecedents and justification, also includes the objective and research questions the hypothesis to prove and the limitations and scope of the results.

Section number two includes the theories that frame the research topic, as well as the teaching and learning process, both in postgraduate studies and with the use of ICTs, theoretical approaches to self-learning and their relationships with self-evaluation within environments Virtual, the concept of Web 2.0 and the search processes on the Web.

The methodological design of the research contemplates the type of research applied, which for this case is empirical, explanatory, applied and quantitative, the sample was of the intentional non-probabilistic type, for having focused the object of study with the criterion of "students with more experience in managing virtual platforms , "instruments of data collection were validated with the Alfa statistic Cronbach, and statistical analysis supported by descriptive analysis, contingency tables and chi 2 independence, the above within Of chapter three.

Section four shows the results obtained in order, that is to say, the description of the sample is first shown in its own characteristics of the investigation, then contingency tables are made between variables that present significance in self-learning, and this chapter is completed with tests Chi2independence and discussion.

The conclusions are reflected in section five of the present study and it is organized according to the objectives achieved, the verification of the research hypothesis, and suggestions for future research and a proposal for improvement for the postgraduate intervention.

General problem conception

In speaking of education, it is necessary to locate the central place of the cultural evolution of humanity, this is given by the contiguous world where it turns on the human and the universe in a general, and this is from generation to generation and affirms the permanence of the continuity of humanity.

Education is a key element in the humanized function, Diaz & Quiroz (2001), define education as; “A process and as a result of training undertaken by members of societies."

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This is a step towards acquiring the ends determined by the sociocultural context of each society and historical epoch for the attainment of an ascent in other extensions of the development of its personality.

In order for the objective of education to be fulfilled, it is necessary to count on knowing how to be, to do and to coexist, being born as a scholarized phenomenon, which represents a conscious process deliberately planned, planned and carried out in educational institutions, for Flórez (2006) The definition of education is understood as: "An active, conscious and effective process in the integral development of the individuals of a society through the creative assimilation of the experience of that society and humanity in its material and spiritual production".

The learning of each culture demands the formation of a knowledge which is substantially related to the systems of representation in which that knowledge is conserved and transmitted by the absolute knowledge technologies in a society, Pozo (2006).

The need to develop a new way of learning is established by the characteristics of the complex thinking paradigm.

The emerging paradigm of complex thinking is transforming our way of seeing the world, awakening the consciousness of the relativity of knowledge and the leading role that fulfills the subjectivity of observer in the construction of reality (Wilber, et al, 2004).

Converting information with organized and meaningful knowledge requires an enormous capacity for reflection, where clear criteria must be faced in the face of the uncertainty of not knowing exact and reassuring answers, this only leads one to think that now the student must.

Have the capabilities to search, select and interpret information, for navigation in a chaotic computer flow, Pozo (2006).

It is understood in this way the way in which education is taking a formative role to discern and take position in front of the facts, that is to say: "What the students need of the education is not so much more information, that can certainly need it, But the capacity to organize and interpret it as well as to make sense of it, "Pozo (2006).

The present society is known as a society of continuous learning (Pozo, 2006), where learning is not limited by time and space, but becomes part of life within the habitual spaces of the human being, this Emphasizes learning to learn, where each student organizes and manages his learning individually.

This means that if current society is interested in satisfying the demands of education, its main key will be to foster students' knowledge management skills or meta-cognitive management, in this way they will be able to face the tasks and challenges Which await perspective in the knowledge society "(Pozo, 2006).

Teaching within a space of collective construction of knowledge, give great experiences of autonomous and self-directed learning promoting teachers to a reflection of the strategies used.

The constant transformations that Education Psychology has had in 30 years has caused self-regulated learning to become a transcendental subject within research and as a fundamental axis of educational practice (Pintrich, 2000).

Beltrán (1996), I believe that learning is an active, cognitive, constructive, meaningful, mediated and self-regulated process.

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In order for a learning to be meaningful and self-regulated, education will have to support students to be aware of their thinking, to be strategic and to guide their motivation towards their own goals, the goal of which is for students to have the need to move from teaching self-reflexive practice, (Schunk DH, & Zimmerman BJ, 1998).

Today education undergoes far-reaching changes, especially in a paradigm shift in the idea of how to teach and learn. This change is highlighted because the learning centered on the teacher, where he had the knowledge from which he would receive and assimilate passively, and the modification is given by emphasizing learning as a central part of the student, becoming a proactive construction Of knowledge, where the teacher becomes a facilitator or guide of learning, in search of an autonomous learning.

That the student works autonomously, does not speak of isolation or abandonment, if not autonomous or self-regulated learning gives the necessary skills and self-management, self-knowledge, as well as having responsibility and self-control of the learning process By the person calling it self-regulation of the learning process, (Fuentes, S., & Rosário, P 2013).

Students with these characteristics are said to learn and improve compared to those who attend passively waiting for the teacher to transmit knowledge, it has been found that those who have greater persistence have a higher motivation, learning more effectively And deep with greater interest and with a positive attitude to learning objectives, (Schunk & Zimmerman, 1998; Pintrich, 200).

Previously, it helps researchers to analyze students' needs, to know about themselves in order to overcome their limitations and achieve their goals (Valle, A. et al., 1999).

Late last century, the concept of learning to learn is reported, is impregnated and supported by the constructivist practice that encourages students to take responsibility for their educational act for their learning, (Rosario, P & Almeida, L.1999).

At present, education is constantly changing in the way it works in the educational field, focusing on younger generations.

It then speaks of a total modification by the teacher from his / her part of cognitive mediation in the processes of education where the student becomes the center of learning, giving greater importance to autonomous and permanent learning, with the introduction of the tools of technologies Informatics and communication more accentuate the self-learning.

Frangniere, G. (1994), points out that the formative processes must be parallel to the transformation of the environment, speaks of a different scenario in Europe and in the world taking into account the fundamental mutations of the human condition.

The Information and Communication Technologies, contribute to the idea of a quality beyond a certain space and time generating virtual and shared spaces.

The origin of Information Technology and Communication (ICT), emerged at the end of the last century with a growth of great importance, this concept emerges as a convergence of electronic technology, software as well as telecommunication infrastructures, and combining these three concepts Communications are born which open up new horizons and paradigms.

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But the evolution that this has had since the 1970s, starting the development of the digital age, in the early 1980's have given an electronic, computer and telecommunications affinity enabling the interconnection of networks , In this way ICT becomes a strategic sector for the new economy.

The inclusion of ICT within the education sector becomes an indispensable component of the information that is now in the computers, which helps to process data, saving time and effort. Bell D. & Brooks H. (1984) define technology as: "The use of scientific knowledge to specify ways of doing things in a reproducible way", this leads to the fact that information technologies are not only generative tools Of final products, but are scientific processes whose main objective is to create knowledge, this speaks of not only is a technical space but also achieves the creation of new forms of global communication.

Then the information technology revolution provokes a crucial and decisive point at the global level, representing the process of democratization of knowledge.

During the last years, different ways to confront the new teaching-learning paradigm have been advanced within the universities, specifically the universities that are managed towards the methodological innovation of ICTs, which play a relevant role. This includes acquisition and development by the teacher, creating the necessary competences that integrate it within the ICT in the teaching-learning process, (UNESCO, 1996).

Learning in the present age is considered as a cognitive process, meaningful and complex, which requires the construction of knowledge from the student who learns, which drives the strategies appropriate to the situation or information of what he wants to be learned, (Zimmerman & Schunck, 2011).

The student must have a process of self-regulation which facilitates the control of what is performing, all this means that it must have autonomy, initiative and decision in the learning process.

One of the educational models accessible to the higher education level that fosters lifelong learning through an innovative educational method that develops critical thinking and student-centered creativity as established by the 1998 World Conference on Higher Education in Paris , Is the model of distance education in its various modalities and nowadays are possible thanks to information and communication technologies, and in the educational field known since the sixties as educational technology, booming in the United States since The 70s.

Distance education was defined by Schlosser & Simonson (2009), and was adopted by the British encyclopedia, such as formal education based on intuition where the learning group is separated and where interactive telecommunications systems are used to connect apprentices, Resources and instructors.
To meet the educational demand with coverage and flexibility, distance education is one of the models that began decades ago in universities in Europe and North America. Today, this educational model is still in force and thanks to the development of the information and communication, takes force in institutions at world, national and state level.

The integration of ICT in the teaching and learning process in Universities at international and national level, particularly in the Autonomous University of Zacatecas (UAZ), began with the beginning of distance education at the postgraduate level.

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This initiative dates back to November 2010, when it was restructured the postgraduate level Masters and Specialty of the Academic Unit of Higher Education, to achieve this objective, a curricular commission was established that established the stages and mechanisms of the process and determined the work centers Which will make it possible to achieve the goal already set. Thus, in February 2011, three educational programs were completed: the Specialization in Information Technology for Education (ETIE) online (the first distance academic program in the UAZ), the Masters in Humanities and Educational Processes (MHPE) Master's Degree in Humanistic and Educational Research (MIHE) with research orientation.

The MHPE was designed with three terminal outputs: in Institutional Processes, in Teaching History and in Educational Technology, the latter under the distance modality.

However, the MHPE with orientation in Educational Technology, was redesigned by its online modality and to be able to apply at the time to the National Program of Postgraduate Quality (PNPC), as a graduate of the non-school type, in the redesign is approved for October Of 2015 the Master's Degree in Information Technology Education (MTIE) as an independent academic program but related to the ETIE in its online mode.

The relevance of this academic program is consistent with state and federal policies according to the basic, higher and postgraduate educational reforms of both private and public institutions, highlighting the importance of incorporating ICT in teaching and learning processes.

In view of these policies and the Institutional Development Plan (2012-2016) of the UAZ, which also includes in one of its main axes the use of Educational Technologies in all its teaching activities and the increase of academic programs online.

The importance of online mode and MTIE is known for the fact that it optimizes economic resources, especially in relation to physical infrastructure of classrooms and buildings, and maintenance and service costs, savings in the displacement of Students from their homes to schools, and fosters the culture of self-study and time management.

Disability, transitory diseases, natural, political and social contingencies, habits and customs, economic of marginal sectors, are an obstacle that prevents the achievement of the objectives of a face-to-face academic program, especially public universities. Distance education and the MTIE is a solution to cover these gaps that prevent the coverage of demand from all social sectors.

The inclusion in the curricula of the use of the free software of digital material in the training of teachers of the MTIE gives an opportunity to the education of knowing the diversity of computer material with license of use and closed code and the one of open code. Without the use of paper in all academic activities, it contributes to the protection of the environment and ecological sustainability.

The purpose of the MTIE educational model is to respond to the missions and functions embodied in international declarations such as the 1998 World Conference on Higher Education in Paris and the UNESCO World Education Forum in Dakar 2000 Key to the development and implementation of educational systems of institutions of prestige worldwide and on which the UAZ Siglo XXI educational model is based.

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From these it is derived that higher education must be a student-centered education, through professional training in both the theoretical and practical aspects, with open and flexible academic programs for all and for life, incorporating the use of the technologies of Information and communication (ICT), as well as a sustained education in research. To achieve this requires a model that responds to the educational needs of the present and solve the problems that affect society.

It should be noted that the proper use of ICT and educational technology depends at all times on the instructional design implemented in such a way as to guarantee a teaching-learning process with quality.

In accordance with the international proposals and the educational demand of the entity and the country, the educational model of the MTIE was designed under an instructional model called ASSURE, developed by; Smaldino, Russell, Heinich and Molenda in 2005 to be offered through a distance education system under online mode.

Definition of the problem

For the realization of this study and definition of the problem to be investigated, it was based on a premise which starts from a dangerous expectation considering that online training requires little effort or minimal application on the part of the student. However, online learning requires as much effort as any learning in other modalities and, the most relevant is that the student has knowledge of the virtual environments, know where he is, what he needs and know how to get it, read and write messages, read And study the learning material, comply with activities and tasks, pass the assessment tests.

The importance of defining the research problem clearly is the core of the work that was carried out, that is why we can define the origin of the problem with findings in the course of the studies of the students of the MTIE, these tracks were presented with most often in a "Lack of skills and appropriate strategies for managing their own knowledge in the virtual arena."

Unaware of strategies and skills in the learning environment and online communication in one of the limiting factors in online training, in addition a basic level of computer skills is fundamental for an online student that is why Hara & Kling (1999) point out that the level of online proficiency of the student can influence their level of frustration.
It is because of the above that the problem becomes important since virtual education should be a student-centered education, through professional training in both theoretical and practical, with academic programs open and flexible for all and for life, incorporating the use of information and communication technologies, as stated in the UAZ Institutional Development Plan 2016.

Justification

The non-presential modalities have become a hopeful measure to solve some problems of the Higher Education System in Mexico, however, there have also been criticisms and suspicions that their practice is far from being a real solution. The public institutions of higher education are making efforts to ensure that the studies offered meet the quality and relevance indicators, despite the fact that there is still a long way to consolidate the distance modality and to have validity and rigor within society.

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Education systems that are supported by information and communication technologies must have a redefinition with respect to traditional models so that this becomes a process of teaching and learning adapted to the needs of those who study today, Already counting on new systems which aspire to an application adapted to the technologies.

The existence of computer technologies has given an innovative sense to education, its applications in the field of education at all levels of education are still the beginning of a new cycle of how to train human beings with self-learning skills in virtual environments.

Technology itself adapts to how, where, why and when learning is carried out, and all elements of teaching are involved; Institution, teacher and student.

It can be said that distance education models have their main emphasis on the student, which is why he becomes the main responsible for their success in this pedagogical model.

The present study shows empirical evidence that, despite confirming some of the factors that have been identified as causing the absence of skills and strategies in the management of own knowledge in virtual environments of students, also expose elements to To design the strategies that should be considered to mitigate them.

Self-management of student learning is a relevant element, without neglecting the part played by the teacher or facilitator as well as the part that corresponds to the well-designed and structured programs in the virtual platforms.

The planning of the web search, the change of ineffective strategies and self-evaluation in the performance of their school activities are considered as the factors that have a direct influence in the development of the good formative tasks of the student, with competences for the Self-learning in virtual environments.

When talking about the advantages that technological resources bring to the teaching-learning processes, there are many, however, it goes beyond just including them with technological tools, a planned, developed and validated pedagogical action is needed.

Objectives

General objective

Explain the main factors that influence self-learning in virtual environments of online postgraduate students of the Master's Degree in Educational Computer Technology of the Autonomous University of Zacatecas.

Specific objectives

1. Describe the skills of searching for academic documents on the Web of postgraduate students online of the Master in Educational Computer Technology of the Autonomous University of Zacatecas.

2. Identify the effective strategies, given in the decisions taken in the search of academic documents on the Web, for the achievement of the objectives of the students of the online postgraduate course of the Master in Educational Computer Technology of the Autonomous University of Zacatecas.

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3. Explain the influence of self-assessment of one's own performance on school skills and its relation to the self-learning of online postgraduate students of the Master's Degree in Educational Computer Technology at the Autonomous University of Zacatecas.

Hypothesis

In order to define the research hypothesis, certain theoretical assumptions about the problem are addressed, ie, a question is raised about the main factors that are related to self-learning, in this way we propose the following research questions:

1. Does planning and rectifying strategies in Web search for academic documentation lead to effective academic tasks for online graduate students?

2. Does self-learning depend on the effectiveness of the academic tasks of online postgraduate students?

3. Is self-evaluation in virtual environments a factor that must be considered to contribute to the development of self-learning for postgraduate students online?

The hypothesis to be tested arises as follows:

Self-learning in virtual environments of online postgraduate students of the Master's Degree in Educational Computer Technology of the Autonomous University of Zacatecas is determined by the planning in the search on the Web, effective strategies and self-evaluation in the performance of their activities School children.

The variables to be considered in the study are reflected in: Dependent variable that corresponds to self-learning in virtual environments and in independent variables defined by Web search planning, non-effective strategies and self-evaluation of academic performance.

Saw. Limitations of the study

The main limitation of the present study is that it is a case study, the results of which are valid for the Master's degree in Educational Computer Technology of the Autonomous University of Zacatecas and for a given period.

The variables considered are determined as nominal qualitative variables characterized by Likert scales, whose analysis must be performed with non-parametric quantitative statistics and levels of significance of 95%.

The selected universe is representative of a generational court that corresponds to students of the fourth semester of the Master in Educational Computer Technology for the academic year 2015-2016.

The data collection instrument was a questionnaire elaborated ad hoc digitally and presented in the platform for its application, validated for its reliability by the statistician of Crobanch Alpha.

The results can be corroborated by applying the methodological design of the present research work.

Metodological design

I type of research

The objectives set and the research hypothesis as the main focus of this study contemplate describing the main factors that influence self-learning in virtual environments.

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In particular those that imply the non-effective search strategies academic documents on the Web and self-evaluation of the own performance in school skills, of the postgraduate students online of the Master in Educational Computer Technology of the Autonomous University of Zacatecas.

For Murillo, W. (2008), applied research is called "practical or empirical research", which is characterized because it seeks the application or use of the knowledge acquired, while others are acquired, after implementing and systematizing Research-based practice. The use of knowledge and research results that results in a rigorous, organized and systematic way of knowing reality.

Therefore you can define this work as an applied research aims as the solution to immediate problems to transform teaching and raise the quality of education based on self - learning students graduate UAZ online.

It is of explanatory type or confirmatory since its goal is the explanation of the phenomena that include non-effective search strategies academics in Web documents and self - assessment of student performance and its relationship with independent learning in virtual environments.

Bavaresco (2006) indicates that this type of research pretends the search, the discovery, the reasons or the reasons of the raised problems. Similarly, Hernández, Fernández and Baptista (2006) consider that explanatory research goes beyond the description of phenomena, that is, they are completely directed to respond to the causes of events and physical or social phenomena. In sum, explanatory research, as its name indicates, has as its main function to find the cause of events or phenomena, that is, to find and identify what is considered the origin of a specific event, in a given case an investigation.

According to the study approach can be defined as a quantitative research, since it mainly focuses it is observable and susceptible aspects qualify them using the empirical methodology analytical and applying statistical suitable for data whose nature come from qualitative variables of nominal type and ordinal.

Hernandez, Fernandez and Baptista (2006) explain that in it, the researcher uses more detailed tools, methods and numerical formulas that allow the solution of a problem.

In this research, a specific statistical analysis is based on the observed and expected frequency measure of central tendency as the median and is known as nonparametric statistics applies.

According to the physical location of research, even if it is virtual can be defined as a field research, as occurs in the natural place of the objects of study is, students graduate MTIE and the results can be generalized in similar situations distance education in graduate school. Bavaresco (2006) indicates that this type of research is that which is done in the study site itself, where the object of it is; thus allowing further knowledge of research problem. According to Arias (2006) field research is one that involves the collection of data directly from the research subjects or reality where facts (primary data) occur.

Not to extend the theoretical knowledge nor reach general laws the ideographic research is that this study presents, and is set to an educational phenomenon in particular as a case study for a well - defined time and at a particular time, which is for students of fourth semester of 2015-2016 school year so also acquires a definition of transversal research . Arias (2006) defines transversal research as the study model by which the researcher has a period of time to run the research analysis.

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Population and sample

The population of students enrolled in the school year 2015-2016 the MTIE in the four semesters is 123 students each semester has four groups, the first two semesters are distributed according to their place of residence, ie groups A and B correspond to foreign students in the state of Zacatecas, and C and D students resident in the state, in the case of the third and fourth semesters distribution is limited to the seminars offered and have a maximum capacity of 17 students per group, and these are formed according to the registration of own students to seminars.

Therefore the universe of research to all students with tuition for the 2015-2016 school year, which has an N (population size) equal to 123 students defined.

The sample is one that can determine the problem and they can generate data with which to identify faults within the process. According to Tamayo & Tamayo (1997) state that the ¨ sample is the group of individuals that is taken from the population, to study a statistical phenomenon.

The sample obtained in the present study is supported by the technique of non - probability sampling and aspirational, the criteria for inclusion of the elements is as follows: The main criterion was to be taken into account students more experience in managing virtual platforms for which all students last semester of graduate studies were selected, ie the fourth semester whose sample (n) results from 33 students divided into groups a and B.

This type of non-probability sampling is the most used in this type of case investigations where there is a target very specific to qualify and where the sample is as representative as possible given the school career of distance students consistent with self-learning in virtual environments.

Techniques measurement tool

Obtaining information was performed with the application of a questionnaire administered to 33 students in the fourth semester of the MTIE constituting the sample, it is noteworthy that the questionnaire was applied online, for which the program was used LimeSurvey, same which allows the application of surveys and / or questionnaires online, and offers the ability to develop, publish and retrieve responses from the surveys, and can be exported to Excel and the SPSS (Statistical Package for the Social Sciences).

The questionnaire was designed according to the operationalization of the variables that define the objectives and research hypotheses, which includes 40 reagents which are the type of closed questions, the first 35 with a Likert scale; 1. Always 2. Almost always 3. Sometimes 4. And 5. Never almost never.

And the other 5 reagents with a measuring scale 1. Analyze the information, 2. Processes information, 3. You contrast with some other source, 4. You write in your work on the subject with your words, 5. The copies and paste it into your work without analyzing the information, 6. You make references on information, 7. You make all the above actions and 8. Do not take any action above.

This questionnaire was subjected to a reliability test to measure the degree of consistency in the answers and in turn validate the instrument in all its reagents with Cronbach's Alpha statistic.

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The result of the screening test as shown in Table No. 3, shows a very acceptable reliability for the instrument that was applied in this investigation.

Cronbach	N elements
0.824	35

Table 1 Statistical reliability

Thus each reagent is expressed in a vector of 40 variables, which in turn defined for each indicator and that related to the research objectives and hypotheses.

Study Concepts	Concept	Indicators (variables)	Unit of measurement
Self-learning in virtual environments	Self-Learning: How to learn by yourself.	X8, X10, X12, X14, X19, X23, X31, X32, X34, X36, X37	Likert scale and multiple choice
Plan Web search	Plan: It is a systematic model that is made before performing an action , in order to direct and manage it.	X1, X3, X6, X9, X11, X18, X20, X21, X22, X24 X25, X26, X27, X29	Likert scale.
Effectiveness of Web Search	Effectiveness: Capacity or ability to achieve a desired goal or purpose.	X5, X15, X38, X39, X40	Likert scale.
Self-assessment of learning	Assessment: Ability to judge their achievements regarding a particular task.	X2, X4, X7, X13, X16, X17, X28, X30 X33, X35	Likert scale.

Table 2 Operationalization of variables

Table iv contingenica and test of independence

Variable 1		Variable 2			Total
		Always	Almost always	Sometimes	
	Always	6	1	0	7
	Almost always	5	6	1	12
	Sometimes	2	2	3	7
	Hardly ever	6	1	0	7
Total		19	10	4	33

Table 3 Variable contingency table 1 * Variable 2

Test (chi - square) seeks to analyze whether two random variables are independent (or are not). That is, you want to test whether or not the occurrence of one of the attributes conditions (or not) the occurrence of the other.
Features Attributes:

Each attribute that is tested is divided into "n" layers:

- Mutually exclusive
- Fully comprehensive

Test hypothesis:

Ho) the attribute attribute X is independent of Y

H1) the X attribute is not independent of attribute Y

Test statistic:

They are:

r = the number of mutually exclusive strata which divides the (X)
s = the number of mutually exclusive strata which divides the (Y)
ei = simple absolute frequencies observed in the sample
e i = simple absolute frequencies that would be expected if they were independent random variables (are calculated using the marginal probabilities).

$$\chi^2_{\{(r-1)*(s-1)\}} = \sum_{i=1}^{k=(r*s)} \frac{(O_i - e_i)^2}{e_i}$$

$$Si : \chi_e^2 < \chi_t^2 \Rightarrow se\ rechaza\ Ho \quad (1)$$

Steps for crosstabulated

a) Ask hypotheses.
b) Define the alpha and establish the rule of decision.
c) Calculate the theoretical critical value of the test $\chi_t^2 = \chi_{(1-\alpha)}^2\{(r-1)*(s-1)\}gl$

d.1 Build a table that contains the observed values.
d.2 Build a table containing expected for the case that attributes are independent values.
d.3 Calculate the empirical value of the test using data from the above tables.

$$\chi_e^2 = \sum_{i=1}^{n=(r*s)} \frac{(O_i - e_i)^2}{e_i} \quad (2)$$

e) Comparing the theoretical value with the empirical and decide on the null hypothesis.

Descriptive Analysis

Answers	Frequency	Percentage		Accumulated percentage
	Always	6	18.2	18.2
	Almost always	fifteen	45.5	63.6
	Sometimes	7	21.2	84.8
	Hardly ever	4	12.1	97.0
	Never	1	3.0	100.0
	Total	33	100.0	

Table 4 The quiz is a capacity of his job performance

Regarding the ability to self-assess the student according to their job performance it is 45.5% almost always evaluate themselves in their practice, while 21.2% do it sometimes and 18.2% of students always evaluate themselves the tasks performed, while 12.2% of students almost never do a 3% admit never have self-assessed.

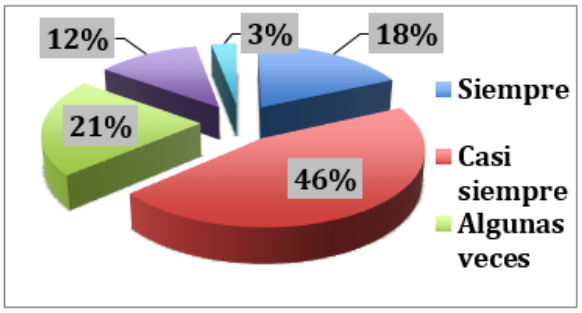

Figure 1 "The quiz is a capacity of his job performance.

Answers	Frequency	Percentage		Accumulated percentage
	Always	17	51.5	51.5
	Almost always	12	36.4	87.9
	Sometimes	3	9.1	97.0
	Hardly ever	1	3.0	100.0
	Total	33	100.0	

Table 5 In assessing the task solving strategies are given

Punctually when they were questioned on the assessment of their tasks and the strategy used to improve these, 51.5% of students responded that employ strategies to improve their tasks, the percentage of students who almost always performed is 36.4% and 9.1% for those who only sometimes does and 3% for those who almost never seek a strategy for the resolution of their results.

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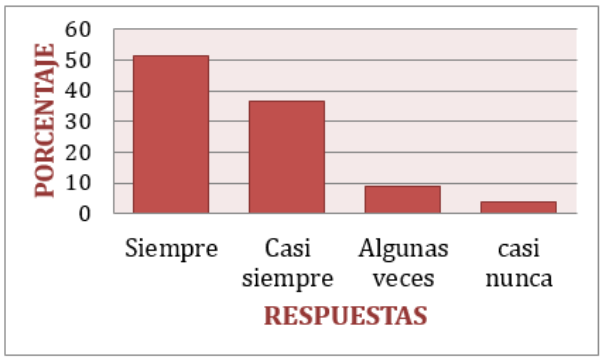

Figure 2 Graph "In evaluating the task-solving strategies are given"

Answers	Frequency	Percentage	Accumulated percentage
Always	eleven	33.3	33.3
Almost always	18	54.5	87.9
Sometimes	4	12.1	100.0
Total	33	100.0	

Table 6 Strategies are designed in search of information.

For a student makes their own strategies must have prior knowledge to carry out this practice, are generally students who raise the situation this way contemplate a strategy that will lead to the answer of research, as you may notice in table No.35 le 54.5% almost always done as opposed strategies 33.3% always have strategies to help them carry out a true and with the objectives set in each task or research investigation. 12.1% ensures only use sometimes as part of their investigations.

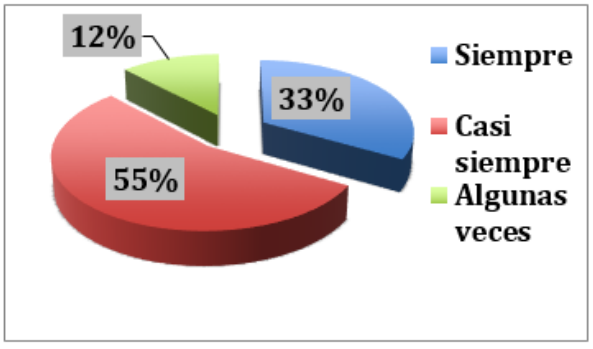

Figure 3 "strategies are designed in search of information"

Answers	Frequency	Percentage	Accumulated percentage
Always	eleven	33.3	33.3
Almost always	7	21.2	54.5
Sometimes	14	42.4	97.0
Hardly ever	1	3.0	100.0
Total	33	100.0	

Table 7 You learn from mistakes in use on the web.

Learning from their mistakes in the use of the web, 42.4% of students believe that only sometimes manage to have a learning from mistakes made while 33.3% say that it has always acquired learning fouls charged, leaving to 21.2% of those students who consider regularly, that is, almost always get a teaching oversights committed, having a 3% almost never has a learning Erras executed.

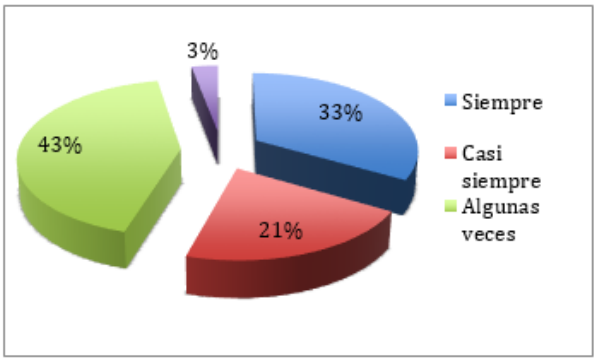

Figure 4 Graph: "You learn from mistakes in using the Web"

Analysis independence Ji 2

The results show the dependency (acceptance of H1), the main research concept "self - learning in virtual environments" with variables that define it, with the three concepts independent; "Plan Web search; Effectiveness of Web search and learning Self - Assessment" with the variables that are significant.

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Dimensión	Definición	Variables involucradas	Unidad de medida
Plan de búsqueda en la Web	Plan: Se trata de un modelo sistemático que se elabora antes de realizar una acción, con el objetivo de dirigirla y encauzarla.	X1, X3, X6, X9, X11,X18,X20, X21, X22, X24 X25, X26, X27, X29	Escala de Likert.
Efectividad de Búsqueda en la Web	Efectividad: Capacidad o facultad para lograr un objetivo o fin deseado.	X5, X15, X38, X39, X40	Escala de Likert.
Autoevaluación del aprendizaje	Autoevaluación: Capacidad de juzgar sus logros respecto a una tarea determinada.	X2,X4,X7,X13, X16,X17,X28,X30 X33,X35	Escala de Likert.

Table 8 Web searching plan

As shown in the table No.1 independent learning in virtual environments characterized by "feedback information through discussion forums, blogs, social networks, etc. "Is dependent Plan Web search characterized by variables " Planning for Web searches, Check whether the solution found corresponds to the objectives and Use information networks for conducting academic work ", the This is confirmed with a level of significance.

Variable dependiente (Y)	Variable independiente (X)	Ha
Y10= Retroalimentar la información en foros de discusión, blogs, redes sociales, etc.	X 11=Planear las búsquedas en la Web.	**
	X18= Revisar si la solución corresponde a los objetivos planteados.	*
Y8= Corregir errores mientras busca información	X 26= Encontrar en las redes la información para los trabajos.	**
	X 8=Utiliza ejemplos de la Web como fuente de aprendizaje	**
	X 11=Planear las búsquedas en la Web.	**
	X18= Revisar si la solución corresponde a los objetivos planteados.	*
	X27=En las bases de datos encuentra información para sus trabajos.	*
Y12= Aprender de los errores	X 22=Utiliza buscadores en la Web.	**
	X26= Encontrar en las redes la información para los trabajos.	*
Y19= Reflexionar los pasos para llegar a la solución de un problema Y23= Cuando resuelve el problema se pregunta si había otra forma de hacerlo	X 25=En foros de discusión encuentra la información.	**
	X 25=En foros de discusión encuentra la información.	**

Table 9 Web searching plan

Dimensión	Definición	Variables involucradas	Unidad de medida
Plan de búsqueda en la Web	Plan: Se trata de un modelo sistemático que se elabora antes de realizar una acción, con el objetivo de dirigirla y encauzarla.	X1, X3, X6, X9, X11,X18,X20, X21, X22, X24 X25, X26, X27, X29	Escala de Likert.
Efectividad de Búsqueda en la Web	Efectividad: Capacidad o facultad para lograr un objetivo o fin deseado.	X5, X15, X38, X39, X40	Escala de Likert.
Autoevaluación del aprendizaje	Autoevaluación: Capacidad de juzgar sus logros respecto a una tarea determinada.	X2,X4,X7,X13, X16,X17,X28,X30 X33,X35	Escala de Likert.

Table 10 Search effectiveness in the wb

In the table No.2 other concept is the effectiveness of Web search that determines the behavior of self - learning in virtual environments, with variable arises "Changing ineffective strategy in the process of finding information" based on the independent variable "regarding reflects the achievements were" whose confidence in the assertion is

Variable dependiente (Y)	Variable Independiente (X)	Ha
Y14= Cambio de estrategia no efectiva en el proceso de búsqueda de información	X15=Se reflexiona con respecto a los logros alcanzados	**
Y19= Reflexionar los pasos para llegar a la solución de un problema	X39=Ver un video.	*
Y36=Consultar Blogs o foros de discusión	X38= Búsqueda en google	*

Table 11 Effectiveness of searching the wb

Dimensión	Definición	Variables involucradas	Unidad de medida
Plan de búsqueda en la Web	Plan: Se trata de un modelo sistemático que se elabora antes de realizar una acción, con el objetivo de dirigirla y encauzarla.	X1, X3, X6, X9, X11,X18,X20, X21, X22, X24 X25, X26, X27, X29	Escala de Likert.
Efectividad de Búsqueda en la Web	Efectividad: Capacidad o facultad para lograr un objetivo o fin deseado.	X5, X15, X38, X39, X40	Escala de Likert.
Autoevaluación del aprendizaje	Autoevaluación: Capacidad de juzgar sus logros respecto a una tarea determinada.	X2,X4,X7,X13, X16,X17,X28,X30 X33,X35	Escala de Likert.

Table 12 Autoevaluación

The self - assess the performance of its activities. The monitor the effectiveness of strategies, ask questions about it to seek and identify deficiencies in solving a task, determines the variable "Feeding back information in discussion forums.

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Blogs, social networks, etc." in relation to the dependence that may exist between self - learning and self - learning in virtual environments, this statement is supported with proof of Ji 2 at the level of significance, as shown in the table No.3

Variable dependiente (Y)	Variable independiente (X)	Ha
Y10= Retroalimentar la información en foros de discusión, blogs, redes sociales, etc.	X15=Supervisar la efectividad de las estrategias.	*
	X16=Autoevalúa el despeño de sus actividades.	**
	X30= Realiza preguntas sobre el tema a buscar.	*
	X35=Identifica sus deficiencias al resolver una tarea.	*
Y12= Aprender de los errores	X16=Autoevalúa el despeño de sus actividades.	*
	X30= Realiza preguntas sobre el tema a buscar.	*
	X33=Identifica los conocimientos útiles para solucionar un problema.	**
Y14= Cambio de estrategia no efectiva en el proceso de búsqueda de información	X17=Evaluar los resultados a mitad del proceso.	*
Y23= Cuando resuelve el problema se pregunta si había otra forma de hacerlo	X28=Confiar en que la información en la Web es verídica.	*

Table 13 Self learning

The "Self - assessment of performance of activities", "Ask questions about searching" and "Identifying useful knowledge to solve problems" determine the variable "Learning from mistakes" in relation to dependence that may exist between learning self - assessment and self - learning in virtual environments, this statement is supported with proof of Ji 2 at the level of significance, as shown in the table No.3

Variable dependiente (Y)	Variable independiente (X)	Ha
Y31= Comprende el problema ante realizar búsqueda	X33=Identifica los conocimientos útiles para solucionar un problema.	**
Y32= Conoce el tema antes de realizar la búsqueda	X33=Identifica los conocimientos útiles para solucionar un problema.	**
Y33= Identifica los conocimientos útiles para solucionar un problema	X35=Identifica sus deficiencias al resolver una tarea.	**
Y34= Diseña estrategias de búsqueda	X35=Identifica sus deficiencias al resolver una tarea.	**

Table 14 Self learning

Identify useful knowledge to solve a problem "determines the" Understanding the problem before search "and presents the No.4 table in a way which establishes the dependence of self - learning in virtual environments regarding the self - assessment of learning, somehow reliance on self -learning in virtual environments is established regarding the self - assessment of learning when the variable " Identifying useful knowledge to solve a problem" affects the "know your subject before search".

The " Identify useful knowledge to solve a problem" determines the variable "Identifying useful knowledge to solve a problem" in relation to the dependence that can exist between self - learning and self - learning in virtual environments, this statement is supported with proof of Ji 2 at the level of significance with a significance level, there is a dependency of the variable "Designing search strategies" with respect to the variable "Identify your weaknesses to solve a task", which determines the self - learning environments virtual regarding the self - assessment of learning

Discussion of results

According to the results obtained in the test of independence Chi 2, it can be said that the " self -learning in virtual environments" depends more on the " Self-learning" whose most recurrent variables in dependence are: X16: Capacity to evaluate themselves in the performance of their tasks, X28: Trust the information contained in the web and X30: Ask questions about the information about looking. These variables are significant in two statistical tests that determine the behavior of self - learning in virtual environments.

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Recurrence of variable X33: Ask questions about the knowledge used to solve the problem, before the search is consideration as to define the behavior of self-learning in virtual environments by having significance in three statistical tests.

And the variable X35: Identify knowledge gaps to solve the task, greater impact presents four tests with significance and which defines the self-assessment of learning, which in turn has outstanding impact on self-learning in virtual environments.

The variables that define better the Plan Web search, with respect to self - learning virtual environments, are determined by X11: Planning the Web searches, X18: Check if the solution corresponds to the objectives, X25: In discussion forums find information and X26: Find in information networks for jobs.

Conclusions

In view of the research problem raised, which concerns the management of their own knowledge of graduate students online MTIE, and consistent with the overall objective of research which is to determine the main factors influencing self-learning. In virtual environments graduate students online Master of Information Technology Education of the Autonomous University of Zacatecas, one can conclude that the variables that determine the self-learning in virtual environments are: a).Correct errors while searching, b) is performed. Blog and forum feedback, c). Learning from mistakes in the search process, d). Changing strategies are not effective in the search process, e).Reflecting on the steps taken to find information on the Web, f). Raise the possibility exists another way to search for information, g). Understand the problem before search, h). It is known on the subject, i). Select only what he brings to the task. J).

Identify the deficiencies in the search y k). Use blogs and forums to analyze information.

In conclusion we can say that the self - learning in virtual environments for the case of students graduate MTIE develops when searching for academic information on the Web when "He knows and understands the subject of the task, is to reflecting on the steps, comparing the possible ways to search and identify individual limitations in skills of computer technology and learn and correct mistakes, selected only what really is important to the task at hand and use blogs and forums for feedback."

As for the specific purpose of describing the search skills academic papers on the Web graduate students online MTIE we can say that these skills are comprised of: a). Planning searches, b).Compare the results with the objectives, c). Find solutions in discussion forums d). Find information on social networks. As to identify effective search strategies we conclude that are defined by a). After the task is aware of the achievements, b). By using the Google search engine is analyzed, processed and contrast the information obtained c). The video is an effective strategy to find valuable information.

When it comes to self - assessment of own school performance skills and their relationship with independent learning in virtual environments can be seen that the most significant variables are: a).The ability to evaluate themselves, b). Relying on information found on the Internet, c).Questioning on the information from the Web, d). Prioritize the knowledge acquired in the search, and e). Accurate knowledge of deficiencies in search skills to perform the task, we can conclude that the objectives were met.

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According to the research hypotheses posed which states that independent learning in virtual environments is determined by the planning searches on the Web, effective strategies and assess themselves in the performance of their school activities we can say that this assertion is accepted.

Independent learning in virtual environments is defined as an independent variable mainly by the habit fed back into blogs and discussion forums should be noted that further precisely how this dependence is between the study variables, we can say with proof of independence Ji 2 with a level of significance that the self - learning in virtual environments graduate students online Master of Educational Information Technology it is determined mainly by the Self - Assessment in the performance of their own school activities, as regards the precise knowledge of deficiencies individual search skills to perform the task and rank the knowledge acquired in the search.

With regard to planning and effective strategies of search, the variables involved have a standard of behavior that has no advantage of one another that is simply self - learning dependence is given about them.

In general we can say that promote Self learning with individual self-diagnostic technology skills in finding information on the Web, such as encouraging students to learn to prioritize their knowledge acquired such searches, teach yourself on students the postgraduate course in virtual environments, would consolidate and impact the quality of online education that is offered today at the Autonomous University of Zacatecas.

For future research related to this research topic (self-learning in virtual environments), according to this experience, we can recommend that in addition to the instruments of data collection with accurate design and scales viable measurement, research is complemented by technical qualitative depth interviews and focus groups that provide a support that pays more research results.

One of the advantages of online education is undoubtedly the power to create non - curricular continuous courses that strengthen student learning is therefore suggested following the results of this research, develop and make available two courses of continuing education, one that is designed to inventory personal abilities of each student, ie a self - diagnosis of the individual skills of the students, and another course where they teach students how hierarchizes knowledge about a particular topic.

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Article
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Incident Management System using the GeneXus platform

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Abstract

This article describes the development of a software tool that allows customers of a certain company to report any incidents to present his system, often by small easily fixable errors. The tool manages the incident through the area of technical support through a ticket service. To meet the need of the company was necessary to develop a responsive web application, access is from their website and also from the GRP system, taking control of incidents presented in all systems under warranty or systems that have support contract technical, shortening waiting times and improving performance RightNow some existing applications such as Unica, Sage CRM, Salesogix, SAS, Microsoft CRM, large and widespread analyzed. This project is specific for each user roles are defined and functionality that correspond to perform the job, the system is based on ITIL best practices for incident management are enabled. The application generates statistics and graphics incidents in PDF format. In addition to having at all times the client informed with email notifications. After an analysis it was decided to use GeneXus for the development of responsive web application. GeneXus is a well structured robust tool that increases productivity and development time thereby making it profitable software business. Also in this work the features of this tool are described Ticketing and results to be implemented in medium software development company

Incidents, ticket, support, GeneXus

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Introduction

Nowadays the use of Information Technology has become a central component of any company or business that seeks sustained growth. The Information Technologies allow the company to offer and distribute services and finished products. In order to be effective, an organization must possess techniques to evaluate the quality of its finished products, as well as for marketing, sales, distribution and for the management of after-sales services to customers. One of the after-sales services to customers is the remote technical support.

This article describes the problem of software companies, when providing remote technical support, the incidents are reported by calls or email but are not always attended immediately, the control of incidents are concentrated in an Excel spreadsheet, which Is shared between the technical support area and developers, which has generated a conflict, in the process of recording incidents and solving them.

The proposed solution to the problem is the development of the "External Incident Management" system. For the development of the application were used various technologies, GeneXus development platform, Java programming language, Apache-tomcat Web Server 8.0.21 and SQL Server 2014 database manager system.

In order to keep users informed in real time, there is a need to design and develop a web page that allows you to record incidents and view the status of the incident in a responsive way -deployed on computer screens, smart phones and tablets-.

Methodology

An analysis of functional requirements was performed.

- Authentication of users for their access to the roles that correspond to the role, through a user account and password
- Customers may register an issue with their software product
- The system will save the incident data and generate a registration record
- The System will allow to assign incidents at two levels. Level 1 to support technicians, level 2 to the technical project leader who sends it to a programmer.
- The System will display the catalog of customers that the company has. As well as registering new customers and modifying information.
- The System will show an interface component that will describe the solution to the incident and the observations on the incident, besides attaching files that evidence the incidence was solved.

The Incident Management System will allow you to indicate a status of termination to the incident through an interface component. Termination states are as follows: terminated, not applicable, test error.

- Displays a list of completed issues to validate.
- Validate incidents

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– Notify the client and approve the incident.

– The System allows to generate reports of incidents by: priority, functionality, for a specific period of time or date and generates graphs. See figure 1

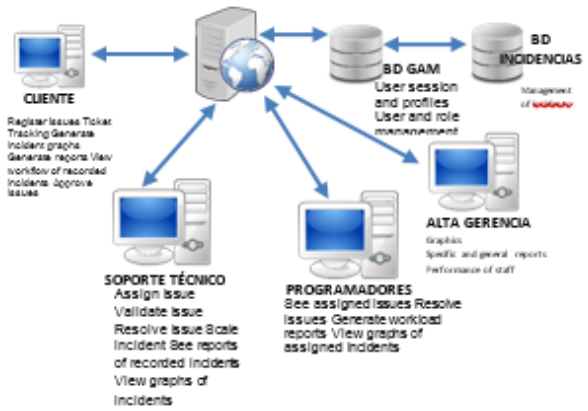

Figure 1 Outline of the functions of the system of incidents

Proposal to solve a problem: customer-oriented process

Figure 2 shows the flowchart to give solution of incidences. Detect and record the incident, to be later classified by the technical support area, if the system has warranty and technical support contract then proceed to an investigation and diagnosis, if it is a problem of configuration or software update is solved in the first level "technical support", in case the incident proceeds to perform a codification this incidence escalates to a second level of care "Development" where a programmer will be responsible for giving solution to the incident and notifying at the first level that it is resolved to procceed to the closure of the incident.

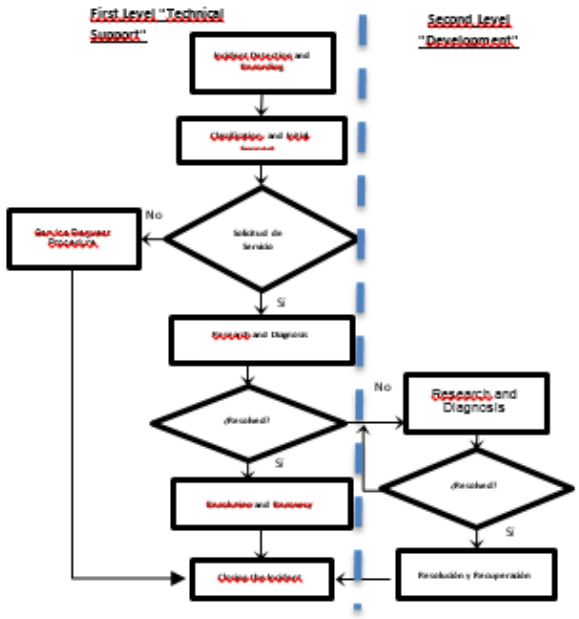

Figure 2 Flowchart: proposal for solution of incidents

We identified actors and their functions, which are specified in figure 3.

Head of Support, Technical, Tester, Technical Project Leader, Programmer. General Manager. Head of Project Management. Head of Project Management.

Incidents are recorded by the user from the website, which can also track their incidence through the service ticket, after the registration technical support performs a research and diagnosis and assigns the incident to the corresponding area for solution, validation and stay pending approval by the client.

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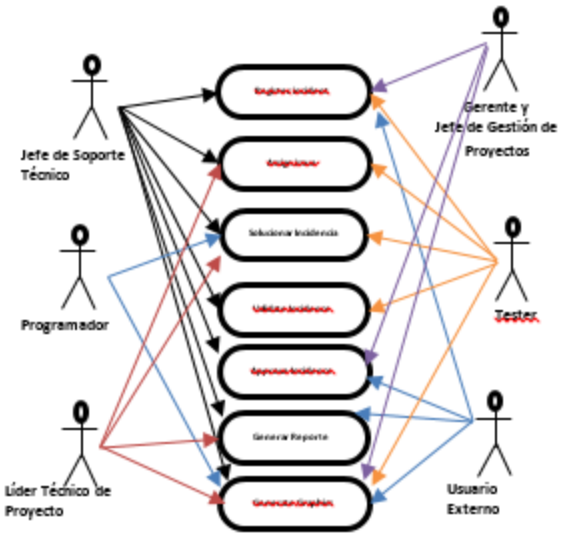

Figura 3 Use case: Process of incidences registration

Environment with the GeneXus development platform

The development environment of the application on the server required GeneXus, Apache Tomcat-8.0.21 and SQL Server 2014 to present the following characteristics.

GeneXus™ is the development platform that creates applications for Web, Windows, mobile devices and legacy platforms, automatically generating and connecting all the functionalities, services and databases that are required. Both client and server side, applications are generated in the desired language, with the optimal data structure.

GeneXus Apps run on:

- Android, BlackBerry, iOS, Windows 8 y 10 (as native apps)
- Amazon Web Services, Windows Azure
- IBM, Linux, UNIX, Windows
- Windows NT, 2000, XP, 7, 8, 10

All browsers and platfomrs

Apps languages:

- Java for Android, Java for BlackBerry, Objective-C for iOS, WinJS, HTML5 & CSS 3 for Windows 8
- Java, .Net
- HTML 5, CSS3 & Javascript
- Supported databases
- IBM DB2
- DB2 para iSeries - System i
- Informix
- Microsoft SQL Server
- MYSQL
- Oracle
- PostgreSQL
- SQL Server CE
- SQL Lite2

Apache-tomcat-8.0.21

Apache Tomcat® software is an open source implementation of Java Servlets, Java Server Pages, Java technologies WebSocket of Java language and Expression. The Java servlet, Java Server Pages, Java and Java language expression WebSocket specifications are developed under the Java Community Process3. 3.3 SQL Server 2014

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Microsoft SQL Server 2014 Express is a free, reliable and powerful data management system that provides a reliable, content-rich data warehouse for desktop applications and light websites4

Database design

A database with thirteen tables was designed, see Figure 4. KB -Knowledge Base - was configured on the Genexus application platform. Apache Tomcat services are started. Establish connection with the SQL-Server 2014 database handler.

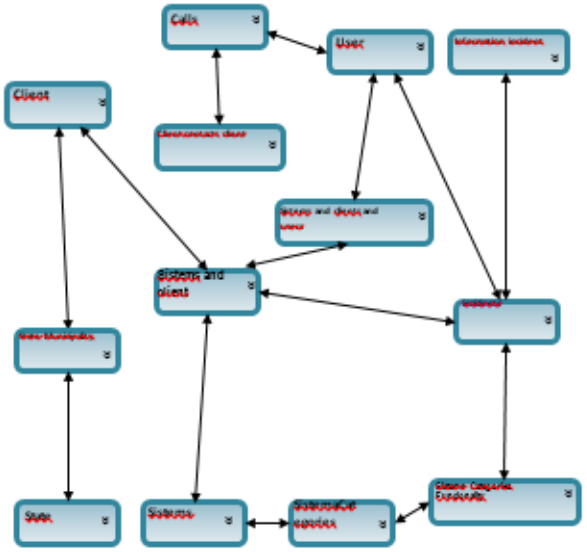

Figure 4 Database design

Incidence record ticket generation

Registration of an incident is made by a telephone call or email, a service ticket is generated, which is obtained from an incremental self-ID, System Id and according to the type of Incidence: Warranty or Technical Support Contract.

The registration ticket is made with the instruction:

IncidenciasTicket=getTicket.Udp(STSistemasIdI,IncidenciasTipo)on beforeinsert;

By means of the service ticket you get the user name, his mail, as well as the following incident data, Customer name, System name, Registration date, Priority, Solution deadline, Description, Menu, Functionality, User that recorded.

The client is notified by email of the incident record:

NotificacionUsuarioExterno.

Call (IncidenciasId) on afterinsert.

The incident is assigned, this is a function available to the Head of Technical Support and Project Leader. The incident can be solved by the Tester, Head of Technical Support, Project Leader or Programmer.

Security is an essential part, in every application in Figure 5 it is possible to observe the security administration process, user registration, assign their corresponding role and depending on whether it is external user or internal user to the company the Corresponding permit is assigned.

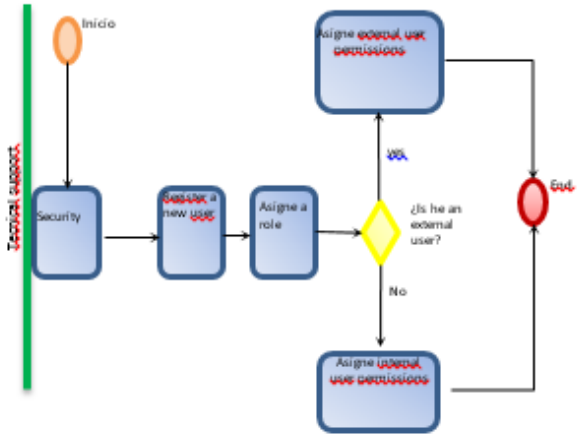

Figure 5 Security administration process

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Quality of the Incident Management System

The Incident Management System is a quality software product, which is why it was subjected to Unit Tests.

Objective. To detect errors in data, logic and algorithms. Exception routines, error routines, parameter handling, validations, ranges, message deployment and reporting of results were considered.

Method. White box.

Integration Test

Objective. To detect interface errors and relationships between components.

Method. White box, Top-Down y Down top

Functionality Test

Objective. To detect fault errors in the implementation of requirements

Method. Functional, Black box, smoke stress, security

Acceptance test

Objective. To detect failures in system implementation.

Method. Functionality.

Results

At the end of the implementation process what was obtained is a web application flexible enough to adapt to the different workflows of the company as a case study.

As well as offering a simple interface where you can check at all times the status of the services offered, customer satisfaction and the times used for it and where the customer can consult and even provide new information on the incidents already created.

An evaluation system was set up to determine the extent to which action is being taken. A sample of incidents was taken to calculate time, effort, errors and time needed for attention. To improve the process of attention of the incidents that present the software products. For this case study it was possible to increase the level of customer satisfaction by 80%.

The tool presents a logical design of modules, user authentication, role creation and permission assignment, attention of allocation processes, solution, validation and approval of incidents, registration processes and generation of service tickets from a responsive web page by enabling a dedicated server. Figure 6 shows the interface for entering the incident management system

The necessary tests were carried out to check the operation of each of the system options. However, the following recommendations are made:

- Enable a server specially dedicated to Incident Management System
- Perform continuous backups of logs of recorded incidents
- Update system catalogs continuously.
- Preventive and corrective maintenance of the system

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Figure 6 Interface

Conclusion

The evolution of software products has brought the need for customer satisfaction at all times. This application is customer oriented and allows an SME to track its software products by measuring customer satisfaction with respect to the software product.

A suitable tool for an SME will have the options that your support center needs today and within the next two or three years. Today there are incident management tools which present options and functions that are not needed. This article presents a methodology and the GeneXus development tool that will allow you to considerably reduce the implementation time and cost required by your incidence management system.

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Electrical characteristics of a Carbon Nanotube Field- Effect Transistor (CNTFET)

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Abstract

In 1965 Gordon Moore predicted that it would have been possible to duplicate the number of transistors in a chip per year. Since then, the number of transistor has increased 3200 times. However it has been predicted that CMOS technology, which is the base of IC's in these days, will reach some important limitations, specially for re-scaling devices into nanoscale regime. In this matter, one of the most interesting options to improve or replace this technology is the use of carbon nanotubes (CNTs) devices, due to their unique electrical and structural properties. In this work we present the electrical characteristics of a CNFET by the I-V behavior, where we have considered a basic geometry, after CNT junction, in order to describe the CNTFET electrical performance. This I-V characteristics were obtained using a compact modelling, and considering a single wall CNT (SWCNT), with semiconductive behavior, in the case, its chirality index is (38,0), and a 3nm diameter, which provides a energy gap Eg of 0.3 eV. In our model we take the approach that the electrical transport in a SWCNT obeys ballistic transport it is posible to get a drain current equation based on Landauer formalism, which takes into a ccount the ideal ohmic contacts approximation, also it allows observing the contribution to the I-V value of the electronic charge present in the CNT sub-bands, in that case, it was interesting to observe that the bigger contribution to the I-V was made by the two first sub-bands.

1D system, CNT, C-CNFET, electrical characteristics

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This work presents I-V curves of the C-CNTFET, based on compact modelling, this model provides a current equation, which is obtained with the assumption that the transport in the CNT is ballistic, in which is ignored the dispertion effects due to the interaction between electrons and lattice vibrations and defects. This model also represents the height barrier modulation in the source (S) and drain (D) regions, which allows settling a comparation between the well known metal-oxide-semiconductor field effect transistor (MOSFET) and CNTFET, this due to MOSFET it is a device that can modulate the current flow in its channel by modelling the potentials applied on its terminals, gate, source and drain.
In this work is necessary the management of the 1D physical aspects, which is the case of the CNTFET, this is due to there is a need to reduce the scale of the devices. One of the areas of electronic technology which requires this procedure is the integration in large scale, so it is necessary to introduce in an small area a huge number of these devices, and they operate as the MOSFET devices do.On the other hand, one of the advantage that is present in the CNTs devices is that the great and unique properties, such as electrical, mechanical, thermical, are intrisec of these CNTs, which is already found in nanometer scale, this situation does not happen in the case of a semiconductor crystal, which necessarily most be designed with the purpose of achieve certain features specially for the design of nanodevices.

C-CNTFET

Compact modelling of CNTFET (C-CNTFET) of A. Raychowdhury [2] it is retaken to investigate the electrical caracteristics of a C-CNTFET, this device has an operational mode that resembles to the MOSFET, in the sense that it is applied the principle of height barrier modulation through the modulation of the potencial applied to gate terminal (VG).

It is due to its own geometry, that C-CNFET allows this performance, in this geometry the CNT gets wrapped by an oxide of high-κ (dielectric constant), which in a way represents a barrier for tunnelling phenomena, after this material another wrapped corresponding to gate material cover the CNT. Figure 1 shows a squematic arrangement of the CNTFET structure exhibiting the source (S), CNT channel and drain (D), such components are supported by a thin oxide film (SiO2) followed by a silicon semiconductor substrate type P++.

The portions corresponding to source and drain, are segments of CNT highly doped, both of them will contribute to the flow of current, as it can be seen on current equation below.

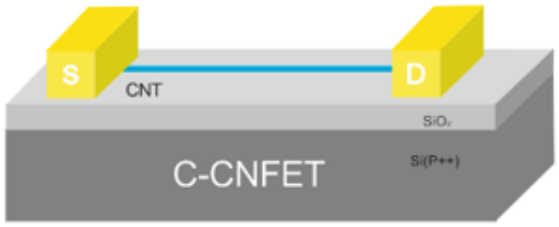

Figure 1 C-CNFET arrangement

Current equation

As it was mentioned before the current equation in the CNTFET is derived under the assumption that there is a ballistic transport in the CNT, so in this case is possible to calculate current can be derivated from Landauer formula, to stablish that such current is as follows [1]

$$I_{ds} = \frac{4qk_BT}{h}\sum_{p=1}^{p=n}\left\{\ln\left(1+e^{\xi_S}\right)-\ln(1+e^{\xi_D})\right\} \quad (1)$$

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Where q, is the charge of electron and p indicates the number of sub-bands that contributes to this value of current, besides is the Boltzmann constant, the absolute temperature and the Planck constant. The parameters ξ_S and ξ_D are determined as

$$\xi\_S=(-\Delta p+q(V\_CNT-V\_S))/(k\_B\ T) \quad (2)$$

$$\xi\_D=(-\Delta p+q(V\_CNT-V\_D))/(k\_B\ T) \quad (3)$$

(2) y (3) are source and drain contributions, and they fill the +k and –k states, which their diference provides the value of VDS, additionally we have that

$$\Delta p = \Delta_1 \frac{6p-3-(-1)^p}{4} \quad (4)$$

$$\Delta_1 = \frac{0.45}{d} = \frac{E_g}{2} \quad (5)$$

Where the Δp is the energy of the bottom of p sub-band and Δ1 is the bottom of the conduction band, is the CNT diameter and Eg its energy gap chosen as according to this model.

Surface potential

Compact modelling considers the value of the potential in the channel using Poisson equation for getting the next consideration

$$V_{CNT} = V_{GS} \text{ for } V_{GS} < \Delta_1 \quad (6)$$

$$V_{CNT} = V_{GS} - \alpha(V_{GS} - \Delta_1) \text{ for } V_{GS} \geq \Delta_1$$

Althought it is a valid adjusment one more precise would be given by the next equation.

$$V_{CNT} = V_{GS} - 0.5\left\{\alpha(V_{GS} - \Delta_1) + \sqrt{(\alpha(V_{GS} - \Delta_1))^2 + 4\varepsilon^2}\right\} \quad (7)$$

The modulation of VCNT potential is given by the modulation of VGS, due the presence of charge in the channel.

Results

When the gate potential VG applied on the CNT increases the energy level in the source and drain barriers decreases producing a major electron flow through the CNT channel. That is the main reason that makes the carrier population increases in each sub-band in the CNT, so there is a need to take into account the contribution of more sub-bands of energy. This fact generates an increment in the channel current I as shown in graphic 1 which depicts the behavior of the channel current I as a function of the gate voltage VGS referenced respect to source keeping the drain-source voltage VDS fixed for each curve. Such curve is obtained considering the contribution of 4 energy sub-bands.

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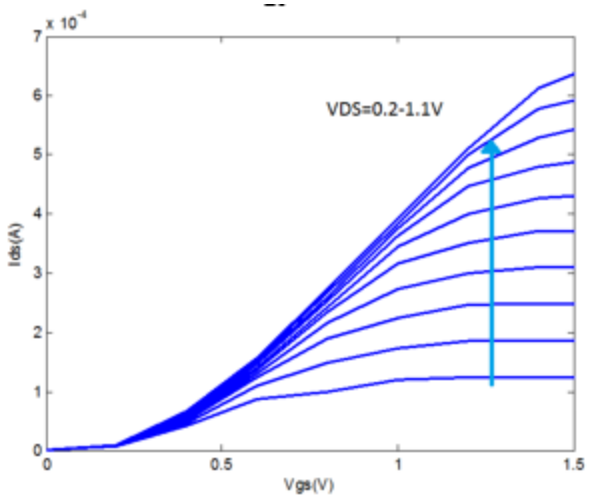
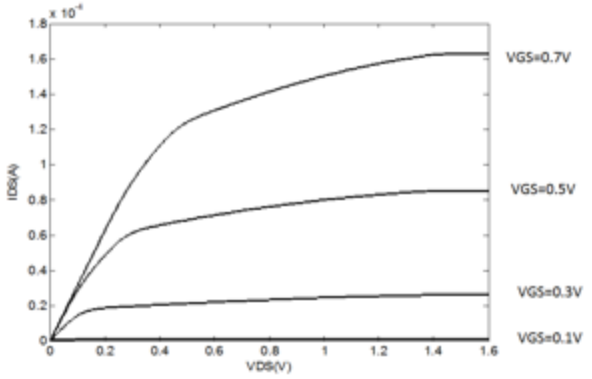


Graphic 1 IDS vs IGS with the contribution of 4 sub-bands, when VDS=0.2-1.1V

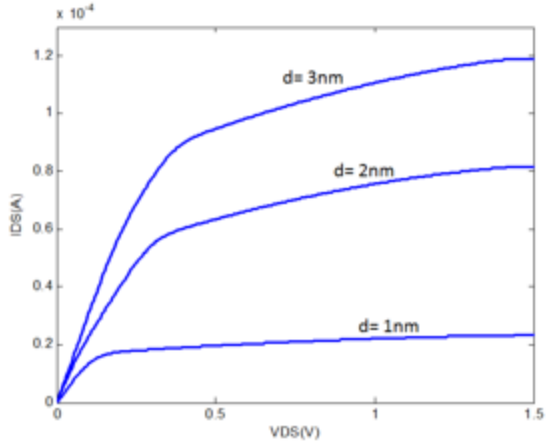
In the case of VGS=0V, the contributions of drain and source are identical but in opposite directions so the channel current is , however when VGS is positive there is an unbalanced contribution with a reduction in drain contribution and it leads to a effective channel current different to zero which is enhanced with increasing of VDS as it can be seen in graphic 1.



Graphic 2 IDS vs VDS with the contribution of 3 sub-bands, when VGS=0.1V, 0.3V, 0.5V, 0.7V.

Besides it is possible to observe that VGS modulation would make a significant variation on carrier transport, it is not the same situation for VDS potential which only increments the inyection of charge carriers through barriers at source and drain regions such barriers have their energy levels height determined by the VGS applied potentials. According to graphic 2, the channel current IDS suffers important increments only in a small range of VDS and so it tends to increment slowly being more significant such increments as the number sub-bands is greater.

Many of the properties of CNTs are determined from the geometry of the nanotube, so it is not really surprising the big influence of nanotube diameter in the current value. It is also possible to see, that this behaviour is related with the reduction of the bandgap, which can be determined in a direct way from the value of CNT diameter as has been demonstrated that [1].



Graphic 3 IGS vs IDS with the contribution of 4 sub-bands, when VGS=0.6 V, d=1nm, 2nm, 3nm

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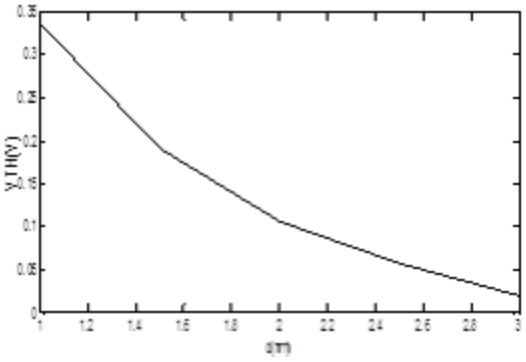
Graphic 3 shows the behavior of channel current in the CNTFET considering three different CNT diameters, as it is shown the current is higher according as the diameter is greater such behavior is expected since the Eg is smaller the diameter is greater and the reduction of the Eg favors the transition of electrons from the valence energy band to conduction band in the CNT and so the electron population is enhanced in the sub-bands and it yields a major current in the channel. Another important parameter which determines the threshold of the channel current and is linked to the CNT diameter is the threshold voltage, which can be expressed in terms of the diameter in the next equation [3]

$$V_{TH} = 0.91 - 0.81d + 0.27d^2 - 0.033d^3 \quad (8)$$



Graphic 4 VTH for diferent CNT diameter values

Graphic 4 exhibits how this parameter is behaved as a function of the CNT diameter, so in general for a bigger value of the CNT diameter VTH will decrease its value monotonically. The increment in the CNT diameter reduces the CNT Eg and it is required a lesser surface potencial to generate transitions of electrons into the sub-bands in the CNT.

Conclusions

One of the most outstanding characteristics is the clear dependence of the electrical characteristics of the CNTFET on the CNT diameter and their sub-bands number, which indicates that there should be a special interest of controlling these values in the synthesis procedures. Another interesting observation deduced from this work is that the bigger contribution to the channel current value will depend on the first sub-bands with important imcrements in the current as increasing VGS values and small variations when increasing theVDS values.

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[3] D. Rechem, S. Latreche (2009), Nanotube Diameter Effect on the CNTFET Performances, 2009 SETIT.

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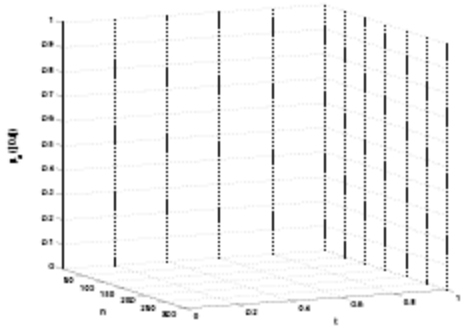

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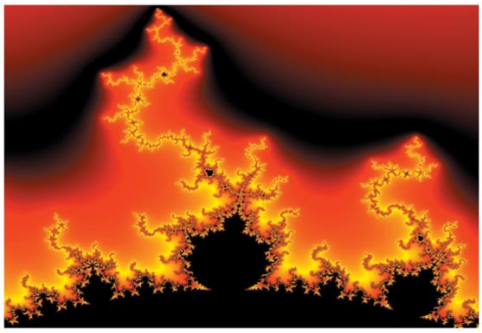

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