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The learning of Photovoltaic Theory in a virtual environment: The case of Facebook

T e s i s

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Presenta:

Mario Rodríguez Castillo.

Directores de tesis: Dr. Mario Humberto Ramírez Díaz.

Dr. Isaías Miranda Viramontes

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THE LEARNING OF PHOTOVOLTAIC THEORY IN A VIRTUAL ENVIRONMENT: THE CASE OF FACEBOOK

Presentada por el alumno:

Rodríguez	Castillo	Mario
Apellido paterno	Apellido materno	Nombre(s)

Con registro: A 1 2 0 7 6 9

aspirante de:

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Mario Rodríguez Castillo

Nombre y firma del alumno(a)

Dedicatoria:

A mi espos,a por su paciencia.

A mis hijas, Tonantzin, Zitlalli y Atziri por dejarme ser su héroe!

Summary.

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Abstract

Facebook is the most popular social network among college students. Its significance has transcended beyond its purpose to the point where is presumed to be able to support a learning environment for teaching physics. The purpose of this research is to investigate if Facebook offers a useful and meaningful educational environment able to support, enhance or strengthen the learning of Physics in college students. The research will conduct an experiment in which observable throw achieve: [1] Identify the concept of students about the use of Facebook as a virtual environment that facilitates learning of physics. [2] Identify instrumentation elements developed by students during the use of Facebook as a learning environment in the subject of photovoltaic theory. [3] Identify the satisfaction of a group of 50 students in their first year of college about the learning experience of the use of Facebook as a learning platform. All this under the perspective of Instrumental Genesis.

Chapter 1: The Research Problem

In this first chapter, which consists of seven sections, we describe the nature of the problem and the importance of this research work from a personal experience in which students themselves suggested the use of Facebook as a tool to support a physics class. In the first section, it is narrated how the enthusiasm for this experiment were generated. After, I introduce the digital native's students and their perspective of learning. Third, I resume some attempts from the academic community on the empowering digital natives learning needs. Fourth, the introduction of the Facebook in the life of these digital natives and their relationship between social environment and education platform. To end, I explain the research questions and hypothesis generated that formed the base for the blastoff of this experiment.

1.1 Introduction to the problem

Facebook. The outline of new technologies –especially social networks- in the classroom has become significant for students. Consequently, more and more university teachers embrace the idea that it can also be used at the academic level not just at a social event (Grosseck, Bran, & Tiru, 2011).

I would like to share my experience as a follow: In the fall of 2010, in a community college at Los Angeles, California, I was participating as an instructor in a class of elementary physics. For this, the physics class needed to be administered under the Blackboard platform. This action -the administration of the class under the Blackboard platform- was not ideal for the student of the class. The usage of the Blackboard platform caused that there were certain problems for students to get engage into the course –student sometimes refused the way in which the class was proposed. After many setbacks about the adaptation of the students upon the use of the administrative platform, we solve the problem. In one occasion, one of the students originated a question about the instruction of physic subject online –specific that class. The student inquired the follow: "Since we dominate the Blackboard platform, we should continue to use it for the learning of the subject". This student's comment was not welcome from many others students. So in this way, the discussion began to form; some students argued that we should study the subject via Facebook, but some other students decline the inquiry. It was so nice seeing the debate of the use of technology in the teaching of physics online. But beyond the point, one student commented that he had witnessed Physics instruction through a virtual

platform Facebook –at the end of the argument he uncovered the benefits of using the social network Facebook as a platform for leaning Physics.

"I saw many students taken the class under the Facebook platform. It looks interesting…"

Another student even contributed.

"I saw students taken Physical Science classes on Facebook. I believe it should be good."

Since the discussion of this particular point, students began to agree that Facebook is an excellent tool to bring the subject of Physics to another level. Another point brought over by the students was the fact that in others countries Facebook is been used with a great potentiality to teach science subjects (Zucker & Light, 2009). After much controversy originated by the discussion of using Facebook as a platform of leaning Physics, one of my students asked me if I could use Facebook for teaching the subject (Physics). My answer to the question was the following: "I haven't had the opportunity to work the educational aspect of this social network, but I believe that as a technological tool, Facebook could develop potential to support online learning ". At the end of the discussion, I started thinking that my concept about Facebook was very ambiguous. Sometimes, I just thought that Facebook have only social net value. School administrators are not very positive about working in this fashion. The education system –more specific school administrators-is just taking advantage of this trend –the industry is reducing the price of computers, so school administrators are pushing forward to this side. Efforts from educators have been in the fashion of adaptation –without any scientific support. For example, in recent years, students have been provided with technology –software, iPad, etc. for the

classroom –most of the time with technologies attached to the Internet. But still nothing close to get the real solution. Exist many problems carried out with the merging of technology but not all is a negative step behind for the classroom for statistics report see (Cabra-Torres & Marciales-Vivas, 2009). But unfortunately, this change is a small step into the satisfaction of new students' academic needs. Another example is the one that educators try to support the education of this kind of student with technology that is not situated according to the need of them. Even do student are very familiar with the usage of technology, technology must be fix in certain way to fulfilling the educational needs of them. This is, technology used at the classroom now, usually is designed for different intention but not to cover educational needs of student –it is generic technology. Educators usually buy programs that are in demand. They supply technology that is commercial produced, and is easy of acquire. The fact is that this kind of technology has a purpose, very determined, that is opposite to the application that the educators want to give to it (Leidner & Jarvenpa a, 1995). In some cases, educators try to fit the characteristic of these new kinds of students into a series of application with different purpose that at the end, the experience of this assisted learning proceed to a no meaningful learning experience.

Different scholars have defined some line to coping different concepts and start merging towards the conclusion of a new framework. They agree that these new students requires more technology. For this, it is necessary to make an effort in the transformation of the educational process, and for this, we see three bases at the first place to begin with [1] demographics, [2] technologies and [3] style of learning. These three bases are the pillars for the next experiment, which will try to find elements for a new framework required by students now. It is very

important that take into consideration this learning characteristic for them. For example (Tapscott, 1999) with the theme of “Generation Net” as well as (Prensky, 2001) and (Howe &Strauss, 2009) they concluded on that this type of students are characterized by the teamwork, experiential activities and the usage of technology. In addition, they are very good working in multiples activities simultaneously.

1.2 Digital Natives, new framework hurdle

As we noticed, we are educating a new category of students- the digital natives. Respecting the research of digital natives (this is the most used terminology to name them), paying attention to their contexts a very important situation. We can see at a glance that education does not meet the social learning demands on them. The student’s performance is affected by the speed of the changes that occur at the social dynamics (Crook, 2012). Students learn differently; students use different learning schemes to adapt to social changes. The learning experience among students is a very complex issue. According to (Juliosilva, 2007) "The classroom is now an increasingly bizarre space for the student, where things happen that have nothing to do with what happens in the rest of society". It seems as if there was no change in the past 30 years. The application exceeded the system. In addition, (Juliosilva, 2007) tells us in a general aspect, this is be a very serious matter, "We are teaching students 21st century with 20th century professors in universities of the 19th century". The need of a new theoretical framework that meets the 21st century student learning needs is a high priority for the whole society.

We can see a trend of governments around the world to find new ways to teach students. For example, the use of technology-computers, video conferencing, Web3.0 - incorporated into the classroom- is very popular at this time (Moore & Kearsley, 2011). Proposals for distance

education, online education, semi-schooled etc. are being developed as well. The development of a new framework that satisfies the need of the digital natives at school is a challenge for any organization. Unfortunately, we are behind of covering satisfactorily the education needs of this kind of students. They're now at college!

There are three issues that are critical for the development of these student's theoretical framework [1] Characterization of how 21-century digital natives student learning. [2] Enhance virtual environments to provide useful and meaningful learning environment by supporting the development of online education. [3] The usage of existing technological tools (Van Eck, 2006). The development of new technologies is a long process and the students has no time, it's in a constant change environment, depending on the nature of the same (Selwyn, 2009). The use of technology should make students to be interested into the study of Physics - as a career.

But despite of this, the situation of contemporary students' education, it seems that is not yet understood. The generation gap between teachers and students is big - to have common learning characteristics. Several studies claim that it is a fact that the generation of educators laid down under the characteristics of digital migrants or some of them even though don't use technology for its professional practice. Educators were prepared in very different circumstances. Regards the use of technology, it seems to be a gap between the communication of the teacher and the student. For example, 90% of students attending this introductory physics course are under the category of contemporary students. As we found that they are listed as "Digital Natives", Prensky, M. (2001) denotes the following characteristics:

> *"Those who were born in the digital age and are permanent users of technology with consummate skill. Its main feature is undoubtedly its technophile. Are attracted to everything related to the new technologies. With technologies meeting their needs for entertainment, fun, communication, information and, perhaps, also training". Being aware of the needs of these new type of students –as an introduction of their environment of learning-, I try to satisfy in certain way, or at least to be more close, their learning experience.*

However, we need to go deeper on this. We need to have a net understating of their environment as the first step to develop their learning framework. Also, Paul A. and Kirschner, Aryn C. Karpinski (2010) give us a better panorama of their finding about these students, they stated as follow:

> *"Welcome to the next generation. Born in the 1980s and 1990s, they spend their days immersed in a media diet accumulating a full-time job most extraordinary devouring all forms of electronic media, communication and entertainment. Multitaskers are teachers, social networkers, electronic communicators and the first to rush to any new technology. They were born surrounded by technology and with each passing year add more tools to your repertoire mail. They live on social networks like Facebook, MySpace and*

SecondLifegathering friends, your text over talking on the phone, and Twitter the night away often sleeping with her vibrating cell phones by their sides. "

The educational practices, for this new generation of students, are very strange to their reality, which is why we have to propose different educational methods to be appropriate to its environment (technological) education. The merging of new educational concepts -designed for them- is necessary to support the educational *process* of this new generation of students.

Another key feature of digital natives is being "Multitasking" which could be defined as the simultaneous execution of two or more activities. According Kirchener (2010) mentions that digital natives have developed, through practice, the ability to quickly change task. Although this is very controversial, regarding the benefits or difficulties caused this kind of attitude, the digital natives tend to do that act between them busy.

The search for a new theoretical framework to support effective learning –of this contemporary student - is urgent. We have to realize that these students are already at college. Unfortunately, they are not in a position to come back and learn with the same framework as we learned- their social environment does not permit. The strengthening of the theoretical framework for the contemporary student must be built on two principles: [1] The technological principle - the use of technology for learning and [2] a learning environment appropriate to their reality.

1.3 A new beginning

In recent years, online education is getting more popular in our education system. There is a great tendency of schools to offer such curricula. For example, online educational opportunities have been doubled (I. E. Allen & Seaman, 2008). For example, in the institution where I work it online classes are very popular. Also, we see universities worldwide - including those traditionally conservative universities - offering online curriculum. Another example is the system created by the government of Mexico: UNAD (Open University and Distance of Mexico). It is a palpable example. It offers degree programs entirely online. Thus, taking into account all these facts, I'd like to say that the future of education is online. The future of education is being pushed right now to a variety of factors, which influence directly and indirectly this trend. We must emphasize that there are a some factors that are essential to direct the education in this direction: The emergence of contemporary student which require different learning dynamic and economics could make governments reduce education costs at 50% with offering online programs (I. E. Allen & Seaman, 2008). Leaving aside the economic part of this, the tendency of education to be offered online, we see that technology has played an important role in the development of this trend. The Internet has been one of the starting points in the online education (Linn, 2013). The technological development of the Internet, now offers a great communication skills - linear, bidirectional, and interactive - for the user. The internet is supplemented with technological tools able to provide interaction between a group of people, and make this an interpretative communication experience at high-level - some might say too close to reality. For example, technological tools offered by the Web 3.0 are very popular nowadays because it offers a communication on different planes and users - including multimedia. But without doubt, the most important technological pillar of the transition from online education are social networks (Shea, Li, Swan, & Pickett, 2005). Social networks have

pushed education - in the trend of going online - to another level. Social networks offer a virtual environment conducive to education for contemporary students (digital natives) according to their characteristics. Social networks are loaded with interactive elements that are assimilated to those used by students in a traditional society - the society in which we live (Papacharissi, 2009). The mobility of education is a very complex issue, but unfortunately it is a fact that we must research and find ways to incorporate it in a way that would be brought in the new theoretical framework for contemporary students.

1.4 The social network of Facebook

To start with this part of the research, let's introduce the thought of Garcia (2008) who tells us that Facebook is not just technology but a tool to serve people. Participants must be on the assumption that students are responsible for their learning. Also, LlorensCerdà, FrancescCapdeferroPlanas, Neus. (2011) tell us that Facebook provides a virtual space in which groups involved in a common goal can discuss, review, organize events ... thus virtual community emerges. Also adding the contribution of Panckhurst, RachelMarsh, Debra. (2011) social networks can be beneficial for the individual and collaborative learning, as they not only provide a greater sense of freedom compared to the supposed limitations of the VLE and LMS, but also encourage students to be more independent and to take greater responsibility for their own learning.

The exploration of technological tools to be incorporated into a new theoretical framework - for contemporary students - shores in search of new concepts. Unfortunately, the development of concepts for Facebook learning environment is a long process. This action seems to be on

par with the technology. We can see that the use of technology is a very quick process, sometimes do not have time to verify results. That's why it is important to make use of the existing technology that is currently marketed - popular and accessible to all-to find the implementation in a given system and exploit it. This process could save us a lot of time and money, and it should be important for the development of the software –having a better application. An example of this is the social network Facebook. Facebook seem that provides certain built-in structure that could make it possible to provide a learning environment suitable for the contemporary student - a useful and meaningful educational environment able to support, enhance or strengthen the teaching of physics. Exploring the virtual platform Facebook, which is the most popular among college students, we could say that its popularity is increasing and more students are using the platform. For this Kabilan, M. K., Ahmad, N. A., Abidin, M. J. Z. (2010) remarks that it's estimated that there are 350 million users of Facebook with 50% of them fall into the non-regular way platform, and 65 million of these come to the platform daily. Thinking the figures could we consider that: Facebook could offer a learning potential to facilitate learning of physics in college students? How Facebook facilitates the learning of Physics? Considering these two facts, the potential of Facebook of reaching a big quantity of students, and the potential to adequate the Facebook platform into students need, we could really go for discovering the Facebook's learning side.

We can consider that students are very optimistic about the potential of Facebook to be using as a learning platform –especially for Physics, but what about the academic community. The people working on the education of these kind of students are a little skeptic. There are some facts about the other side of this research. However, despite this boom that has taken over social media use beyond their capabilities, we can tell that there is apathy for the exploration of these

type of issues –in the academic side. Social networks have been seen from a neutral point of view without the ability to provide a virtual environment conducive to learning. Therefore, the research of this topic has been of interest to the scientific community. For example, Sanchez (2010) tells us in his paper:

> *"I have witnessed this kind of attitude in other educators in the Community; there is a lack of sensitivity to the potential of Web 2.0 tools to practice and research in education*."

In the field of physic education, we could say that researchers are not looking into this potential at all. Some believe that the potential of using Facebook as an educational tool is negligible (Tiryakioglu & Erzurum, 2011). The lack of research papers by the academic community is a fact. Even with this lack of interest, some communities work in the discovering of potentiality for education on Facebook. There are some experiments among the community which demonstrate and guide teachers how to use the Facebook in a classroom for the purpose of teaching ("The Facebook Guide For Teachers," 2013). In addition, we can find a lot of literature that can guide us to explore, meet some approaches, understand the advantages and disadvantages of using Facebook as a technological tool (Manca & Ranieri, 2013).But nothing has been approximated to the field of physics education. It seems that physics education researchers only work on the construction of the classic theoretical framework to frame this branch of physics. At the end, truly believe that the beginning of a new framework has been start it. We need to make an extra effort to focus the exercises to discover the potential of this framework.

1.5 The research problem

To answer the project's research questions, we retook the problem about learning through technology. In addition to this, we can also assume that returns a new framework to accommodate the learning of a new generation of contemporaneous students. As previously proposed, finding this new type of context led many researchers to take certain paths that in many cases has not been adequate. This new project incorporates the learning characteristics of the new contemporaneous students. As it has been intended to reflect the contemporary learning style generated by students on practical learning and makes a hypothesis about the possibility that, they approach to the use of technology tools and learning use as well.

Generate research questions was not easy, since it is intended to incorporate at least 3 types of factors –prior mentioned- that are paramount in the development of a new framework for contemporaneous students.

1.6 Research questions

In order to analyze the concept, practice and satisfaction of virtually aided learning of new contemporary students, especially those characteristics that make their environment an asset to learn, we propose the following research questions:

1. ***Artifact or instrument? What is the student's concept regards Facebook as virtual learning environment to cram the photovoltaic theory?***

2. ***Under the perspective of the "Instrumental Genesis", how the use of Facebook as a learning environment facilitates the learning of the photovoltaic theory in contemporary college?***

3. ***What is the students' satisfaction about their learning experience induced by the use of Facebook as virtual environment for learning Physics?***

The purpose of providing answers to these three research questions is to explore experiments that have been conducted around the world as a part of the development of this new theoretical framework thus strengthen the learning practice of contemporary students about the physics subjects. Furthermore, analyze the students' resources and didactic skills when is exposed in a virtual environment given for the Facebook environment exposure.

1.7 Objectives

To answer these three research questions in this project we proposed the following objectives:

a) According to research by ("Discussions-Teaching Excellence & Educational Innovation - Carnegie Mellon University," n.d.) which tells us that one of the best ways to introducer students and motivate them to thus ensure quality teaching is the practice of active participation. According to (Bazerman, 2005) it is important

for the physics student that participate in a curriculum that is attractive. This means that the student can improve his/her attitude towards the course in a more comprehensive way when you are participle in the curriculum development. For example, ask a student what the ideal practice of physics would be? This is a very positive practice and can have very favorable results when you give to students the opportunity of design the class. Inquiry for questionnaires will be develop in the order of two consideration. Consideration of students to design resources to use in the Facebook platform and the seeking of students conceptions about the use of Facebook as a virtual platform of learning the subject as the photovoltaic theory.

Observed preconceptions and enthusiasm aptitudes from students indicate that perceptively students support the idea that Facebook positively complying with the fact of providing enough elements to sustenance the learning of the photovoltaic theory in an academic and formal way. Thus, students' conceptions will be screening to validate this statement.

This is the way to carry out the resolution of the first research question.

b) For the second research question, the objective is to obtain schemes of use typical of contemporary students using technology. According to (Rabardel* & Beguin, 2005) the instrumented approach, utilization schemes are structured by reference variants and operative knowledge of the artifacts that the subject. That is, these schemes use finding and classifying in an appropriate manner. According to (Makonye & Luneta, 2014) schemes use are not easy to build, people can develop appropriate to resolve the situation, insufficiency or passed on wrong conceptions schemes. Also (Drijvers & Gravemeijer, 2005) emphasizes that schemes use

cannot be observed directly on the subject, but only in practice. Instrumental genesis we will give us a new perspective about contemporaneous students and how they move into a new learning environment.

It is being presumed that contemporary students no comply with the phenomenology stated by the origin of the Instrumental Genesis theoretical perspective. Even more, the generation of Instrumental Genesis derivatives not amid in the construction of the instrumentation more, those outputs are no worthy for the discovering of intrinsically generated elements to procure the meaning of the instrument. It is alleged that technology is already embedded on them.

Questions and observations are proposed to conceptualize the phenomenology proper of the instrumental genesis –instrumentalisation and instrumentation to build new scheme of use for artifact's appropriation.

c) After entering the contemporaneous participation of students in the curriculum and to expose them in an environment in which it is presumed that is ideal for their type of learning, we propose to survey the satisfaction about their learning experience.

Misconceptions can be rerouted by conceived experiences in the fashion of being exposed to a meaningful framework. Students aim that the level of expectation given by the exposure of learning supported by the virtual environment offered by Facebook is already set. For them, Facebook is a powerful instrument able to support and enhance the learning of a physic subject such as the photovoltaic theory in the inhibited environment provided by the instrument. With any doubt, satisfaction on the use of this means is truly vast.

For this, questionnaire will be the mean to embrace the after-experience answers regard the sustainability of Facebook as a learning virtual environment.

The ultimate objective for this research is finding elements that contribute to the construction of a new curricular framework that fits these contemporary students under the perspective of contribution and observations of instrumentation schemes to the point of transforming the artifact called Facebook as instrument.

The students will play a major role. The participation collecting ideas about the best way to use Facebook academically and learning approach at the time of interact at Facebook will be with any doubt a great contribution for the seeking of this new framework.

The answer of these three research questions aims to obtain elements that prove or disapprove the ability to the use of Facebook as a methodological tool that offers a useful and meaningful educational environment able to support, enhance or strengthen the learning of Physics in college students.

Chapter 2: State of the art

Finding a new frame of reference to educate these new contemporary students is innovative work. For this chapter, I intend to make an approximation to the instrumental genesis in which we try to frame some advantages of the platform of Facebook when is used as a virtual platform of education. Also, we will make a review to different works that have been developed on this concept. And finally, we will try to make an introspection about the use of Facebook under a representative framework of instrumental genesis.

2.1 Introduction

To answer research questions, I will frame this experiment under the perspective of "Instrumental Genesis". The complexity and lack of in-depth studies are some of the key features that characterize the Genesis instrumental theory. Nevertheless, despite being an emerging theory and under construction process, the instrumental genesis has served to validate certain elements that were measured in the primordial nature in the use of technology as a learning tool.

As I mentioned in the context of this paper, the Facebook learning environment literature involving this field of physics education is reduced. Nevertheless, we can realize that there are certain works of different nature (internet, manuals, studies, etc.) that demonstrate and guide teachers in the use of Facebook as a learning tool. In addition, we can find many sites on the Internet, which offer some explanation about the uses of Facebook as well as its advantages and disadvantages. Although the framework of most of these documents were not developed for the purpose of the physical education, it is possible to experiment in a plane of an educational fashion, so in this way, we can find the potential of Facebook as a learning environment. So in this way, we can start working towards the construction of a framework in Physics Education.

2.2 The Instrumental Genesis

To introduce the Instrumental Genesis as general theory in this experiment, let's concentrate on the origins of it. The beginning of this theory is conducive to the search of the relationship between learning and the tools used for its process -the influence of the tool in learning process. Vy (1978) mentioned that theoretical tools mediate the learning process. This proposal -which probably started the origins of this relationship- is the focus for subsequent studies performed by Rabadel (1995) which are the basis of this document. Several authors have taken this framework to conduct research in an instrumental approach. We could highlight the work of Artigue (1997), Trouche (2000) and Lagrange (2000).

Most of the research concerning the conceptual framework of "Instrumental Genesis" is based on studies of mathematics education. Because of this, we must emphasize that the implementation of Instrumental Genesis tends to evolve into other education areas such as Physics Education; there is a great potential of application due to factors such as the modernization of education and the emergence of a new generation of students –the digital natives.

Now, let's begin to describe in a deeper fashion the "Instrumental Genesis" theory and its application attributes. Broadly speaking, accordingly with Trouche, L. (2004) we could consider that the transformation of the artifact into an instrument, where the idea of the instrument is the result of a construction shape by the user under instrumentalisation and instrumentation process, this is called The Instrumental Genesis. The instrumentalisation is a recognition of the functions of the artifact and the instrumentation is an idea, a mental

construction ingredient when the user uses technology and brings it to develop and understand their mathematical activity(Trouche, 2004). On the other hand, we can also mediate Instrumental Genesis as the development moment about the usage of the artifact by the user in a productive way, a number of schemes converge instrumentation. Guin D. &Trouche L. (1999) and Trouche, L. (2004) told us that the development process of understanding the conversion of the artifact into an instrument is a long and difficult process to understand. The instrumentalisation elaborates schemes of use and instrumentation schemes of action.

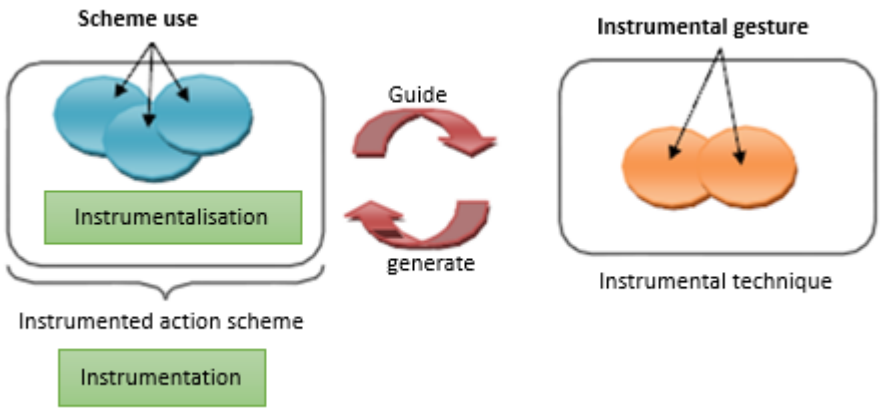

Fig. 1: Instrumental Genesis Model

The application of the theory - Instrumental Genesis - in this research is the one proposed by Trouche (2000). For this, Trouche (2000) proposed as scheme a stable mental organization that includes techniques and concepts supporting the use the artifact on a specific class of tasks. As mentioned previously, Trouche (2000) distinguishes these two schemes as follows. [1] Scheme of use and [2] instrumented action scheme. The schemes of use are those that could presume to be related to the artifact. Considering some examples of them, we could say that they are the

attributes or users' skills depending on the use of Facebook, such as entering text on walls, photo uploads, etc. An experienced user in the use of Facebook could use these schemes accurately, but an inexperienced user should pay attention to the attributes of the Facebook's functions and also in the conceptual aspects of Facebook. The instrumented actions correspond to the realization of the transformation of an object with the activity; in this case, they are Physical entities such as formulas, graphs, definitions, concepts and so forth. Instrumented action schemes have a mind meaning and they're constructed on based on basic to the elemental scheme of use throughout the process of Instrumental Genesis Cedillo (2006).

2.3 Instrumental Genesis: Its implementation

How this theory is applied using Fb? Cedillo (2006) proposes an example of instrumented action to us. In this interpretation, the author says:

"An example of instrumented action is the determination of the scale to observe a graph on a calculator. To be developed instrumented action scheme like this, it is necessary that the user possesses technical skills to set the dimensions of the window you will see the graph, mental abilities that allow you to imagine the calculator screen and a clear vision of how it can be presented in the window that displays the graph in an infinite plane. Where the position and size of the window is determining whether or not we can see what we are interested in this plot."

Reviewing this example, we can find two elements that are the basis of Instrumental Genesis. The first element is the use scheme. Technical skills needed for using the calculator obey to the principle of use schemes. The user must have some skill to operate the artifact. This is shape by a prior experience using the artifact. For example, watching others in the use of the artifact. In other words, the ability or experience from the user in handling the functions of the calculator. The second element, discussed in the example, refers to the mental ability to interpret the concept through the screen. This principle reflects instrumentation; the ability to imagine the concept and its interpretation on a screen as the result of an instrumentation, which was able to give the skill to the users for a conceptual interpretation.

Good example, but still some doubts!

Let’s try another one more time on an instrumentation process example -a short case of study by (Heid & Blume, 2008). In this, we experience in the drafting of a document (a word processor) without considering the hermeneutic aspect involved in this process. Here exist two points, the first order of use that is going to help the process of using the word processing artifact. The user has to have some experience using the application; for example, knowing "menus", attributes, modifiers, etc. This scheme of use may depend on the skill of using a word processor and the use of the word processor by itself-a long and tedious time. In addition, there was developed an instrumented action scheme. This would put it in the way that the user has the ability to understanding the idea in which he/she work. That is, when a user types in a word processor, the user has a limited access to the wording. In a different angle, the user, when writes, can only see one third of a page, this could reach only one paragraph of the idea embodied in the document; this is how the manipulation rests on the idea developed in the

user's mind. The whole argument for the creation of the idea and its written submission lies on the concept of writing. The drafting process that requires for writing a paper, the technique, style, review, etc., are in the user's mind, but are part of the writing process in a word processor.

Yes, beautiful examples but, how can I Interpreting the Genesis Instrumental at Facebook level?

2.4 The Instrumental Genesis and Facebook

Knowing that Facebook will be use -in this experiment- as a technological tool for learning, the proposal is as follows: in order that an instrumentalisation process exists by the use of Fb as technological tool, the student of physics must undergo a schematic of use process. This scheme is channeled in two dimensions, first, the pattern of use. This will be responsible for the management of the Facebook platform for maximum utilization. That is, contemporary students, as described priory, have a knack for using digital tools- Facebook for example. This ability will make them understand in a more extensive way the Facebook platform. In other words, the pattern of us-part of the instrumentalisation process- will be given in the act of management the capacity of the Facebook platform.

The development of the ability to use Facebook as a learning platform –how to use menus, how to use chartrooms, writing on the wall for discussion in an academic way -are the results of the implementation of schemes of use in an instrumentation process. It has been presumed that

contemporary student (digital natives) no experiences scheme of use; it would seem that they are directly related to the artifact.

One feature of contemporary student (digital native) is the use of technology. The contemporary student is immersed in a technology environment in their daily lives. At all times and everywhere, they have technology around them. Their environment is in a constant use of technology (Ertmer, 2005). This part of the use of technology can indicate a breakthrough -about the instrumentation process- in the use of technology. This is, the factor of schemes of use of a contemporary student not exist due to the relationship of digital natives and technology. Moreover, in some way, I could said that the use of Facebook is for many of them, an instrumented act –meaning that they don't have to go through instrumentation process all the time when they use technology –probably they are in the top of the use technology. Using Facebook, for many contemporary students was a product of a relationship of factors that followed by a social practice eventually resulted on an instrumentation process. To use the platform Facebook around the digital natives -as a social network- stepped into an instrumentation process. Thus, their constant action gives them the tools to convert Facebook into a social instrument of communication. From that moment, the Facebook platform went from being an artifact to become an instrument that allow them coexist in a virtual fashion– socializing and communicating. The instrumentation process exists in a certain way and helps them socialize virtually.

Now, if so, it would be important to migrate the existing framework and focus on the learning achievement in Physics Education aided with technology. Then, coming back to the second

dimension –of the instrumentation process- is necessary an instrumented action category. It is eminent that Facebook offers a wide range potential of applications. Although its function - as a social network - is other than educational, this application offers great potential to be applied on physics education. Facebook offers three essential elements-bearing in mind that the platform has more elements- for implementation. These are: "Wall", "Notes" and "Events". The development of an instrumentation process capable to overcome these three elements, incorporated into FB, are the basis of the instrumented actions and are in charge of providing users the instrumented action schemes necessary for the process of instrumentation. Then, these three elements are exploited in such a way the students will be provided themselves with elements to create the idea of the studied concept. In this way, students in the process of adoption, create a conceptual idea enough to support the learning of Physics by the usage of Facebook platform –this mean creating an instrumentation process. This action is similar to the one that is been taking place in a social network, in which the contemporary student will be able to abstract the physics educational content for its use. In other words, the use of these three elements, under the platform of Facebook, develop mental skills that will enable students to imagine (idealizing) the representation of an educational concept - in this case the PV theory. Thus, the instrumentation process will be implemented.

Schemes of use come into play the actions and thoughts getting involved into techniques to use an artifact and its relationship with the mental concepts Cedillo (2006). In this case, the representation of learning objects of Physics-like study elements- and the reasoning process of these objects under a given structure giving by the use of the platform Facebook is considered as the abstraction process of the Instrumental Genesis.

In this way, the Instrumental Genesis will be taking into consideration to design either the analysis of data as well as the design of experimental designed methodology. In the following chapter, methodological aspect will be shown for the present investigation project.

Chapter 3:

Didactic of Photovoltaic Theory

In this third chapter, divided into 5 sections, we describe the didactics of photovoltaic theory. Section one emphasizes the importance of the study of physics in the economic development of the United States of America. Section 2 describes the process that has been followed by physics in the use of the internet in the classroom allowing classes online. Section three and four explains the use of Facebook as a means of interaction and virtual environments in classrooms; Looking for the point of intersection between these two. The chapter culminates with section 5 describing the relationship between Educational Physics and the teaching of photovoltaic theory describing the didactic elements developed in this experiment.

3.1 Science: The America's economic engine

They are many challenges for federal and state governments in the US responding to economic challenges and investing on superior education and research since the end of the WWII. to maintain the position of the USA as worldwide economic power nation (Zakaria, 2008). We can said that with the case of the Cold War, it were an urgent development for the sciences that facilitate the development of science, technology, engineering and mathematics (Kleinman & Solovey, 1995). Then after the Vietnam War, the teaching of science experimented a decrease of public support on research (Zakaria, 2008). Then we can say that the private sector filled the gap left by public funds dedicated to higher education and research wing. In these times, we can refer many events in the global economy which are those having set a standard for the nations of the world invest in scientific and technological research.

Maintaining the competitive aspect of the United States, as a world power, requires the creation of many jobs in areas such as green energy, nanotechnology, health care and engineering. Most of these professionals who will make destined to work in these areas are critical being educated by public universities in which 80% of the student population of the United States are educated ("American Competitiveness Initiative," n.d.).

Meeting this goal is not an easy task. Many changes on cultural aspects, social issues, and economical involvements are required.

Many scholars argue that there is now a generation gap for science education. That is, students currently attend Elementary schools' systems in the United States tend to have apathy towards science and mathematics subjects. I've been a witness that the government of the United States made a gigantic effort in creating programs and curriculum changes to the new needs of contemporary students in the schools of the states.

One of the biggest changes in schools in the United States will that resume on science teaching is the addition of online education. The incorporation of these technologies designed for learning the sciences acid well accepted by college students in the United States. For example From 2000 to 2008 , the percentage of undergraduates enrolled in distance education at Least one class expanded from 8 percent to 20 percent , and the percentage enrolled in a distance education degree program Increased from 2 percent to 4 percent ("Learning at a Distance," 2011).

In his document (Frye, 1997) shows us that we can see the US suffering in science education more than other branches of education decline. That is why the United States government has committed to online science education to fomenter some big steps in the process towards an increment the interest of science education

Distance education is definitely a great tool not only in general for the academic aspect of learning but also an important part for tutoring science. Although still a well-defined online studio for science framework is not found, governments around the world make stress upon this tool and some of them are betting heavily in the development of it.

3.2 Science distance education: The case of the Physics

The history of the online education in the USA is relatively short. Even do some people believe that sufficient time has not elapsed to mature("History of Online Education | SayCampusLife," n.d.). Some other people think opposite. Some records show us that the University of Illinois developed the first environment set up for a virtual classroom in 1965. According to("History of Online Education | SayCampusLife," n.d.) University of Illinois scientists created a classroom system based in linked computer terminals. There, students were able to access informational resources while listening to a professor whose lectures were brought in remotely, via some form of television or audio device. It was the first attempt in the USA for the developing on an online virtual classroom.

From that specific moment, universities started to take advantage of this new resource. Suddenly they began to see more and more online classes. This event was not only for schools of the third or second tier but also prestigious universities began to develop these programs. The interest in many schools start growing about this new resource. We can say that it was a new movement. In many universities started not just taking advantage of this mean to teach student but also the development of new framework fitting the need of this new resource. Unfortunately, theoretical framework in which this new learning system was developed was not sufficient. So that began to work in the same way nothing different; School try to frame these kinds of courses in the same context as the one given for ground classes. So we can say that it started to become a new research line (Funtowicz & Ravetz, 1993).

Online courses started growing at a very fast pace since the 1980's. Different groups emerged outside the academy that also started to develop education programs in that environment. For example, Military started taking advantage of this resource focusing in training soldiers. In this way, they cut some senses to their budget. In addition, corporations started seeing this full of potentials (Bonk & Wisher, 2000).

“While businesses began with software training programs, the largest corporations started utilizing online tools to minimize software distribution costs (Bavilacqua & Gianneto, 2003).

It was a big start on distance education supporting education in many areas but science and math. The theoretical framework used for the teaching of mathematics and physics is a very particular theoretical framework that is very difficult to carry out in a remote way. That is why many school administrators have stopped in the development of science and math programs for their online education. It is visible to see at this time the great backwardness of programs in mathematics and science. Despite all efforts during all these years, everything concludes that we still have that academic backwardness in these two educational lines.

There is no doubt that online education had been very controversial in recent years but certainly, physics education in a virtual manner has been a taboo so that we can clearly see a major setback in comparison with other fields of education (Gaimster, 2008).

The model of science education in the United States is very particular. In engineering education, the adoption rate of effective online educational strategies has been lower than in other disciplines. The importance of laboratory and hands-on experiments, as well as ABET accreditation policies are likely to be part of the reason for this gap. (Reynolds & Huisman,

n.d.).The combination of lectures and laboratory is the prime rule for universities. That is, they create an accreditation system which govern the model for science education. Any other institution outside of this system have to introduce their educational programs in science and engineering -in The United States- first. These agencies are responsible for standardize educational programs(Chou, Chan, & Lin, 2003).

By showing a moment, the consequences brought by the introduction of technology in the areas of everyday life, we can see that also in curriculum development has been affected by technology. That is, technology has been focus on developing curricula, so this, it has been growing at incredibly fast speed. For example, we can see that curricular standards have to be changed so often in this way the demand for education for new contemporary students is satisfied (“Principles of Effective Change: Curriculum Revision That Works,” n.d.). We can also say that these contemporary students are exposed to a lot of technology that does change their thinking; technology works in all branches of life and besides that everything around has to be changed to be in its proper environment.

The search for new technologies goes far beyond this principle and its theoretical framework developed for the teaching of physics to contemporary students. This has more governess of his application so quickly that cannot be executed in a traditional way (Krusberg, 2007). Many physics faculty come away from teaching introductory physics deeply dismayed with how little the majority of their students have learned. Even worse, the growing importance of technological literacy in the workplace makes it increasingly important for us to provide value to more of our students (Redish & Steinberg, 1999). That's why many researchers have not

taken the task of developing a new theoretical framework that can be sustainable for the education of these new contemporary students but looking applications that allow teachers have tools to help them take a better learning experience to students (Krusberg, 2007).

3.3 Facebook and the virtual environment

Facebook is the most important social network in the internet right now. Its contributions to the Internet are different in the nature as a social network. For example, we can see applications beyond its design. These cover functions in diverse areas such as commerce, education, government etc. The progress of this social network in a diverse range of applications has been very great that caught the interest of some researchers in education. All this with the desire to use this popular tool for many contemporary students as a platform for virtual education.

There are various publications about the use of Facebook in connection with the classroom. For example (M. Allen, 2012) show us your work different perspectives on academic arguments and all the debates that have been generated about education in the Facebook platform, it also shows us a perspective on how the world sees the virtual platform of Facebook as a social network without have no educational purpose but simply to entertain. Finally, broking down certain factors that make the social network Facebook into a powerful tool that helped many students to be more interested about their education.

Different theories have been developed about learning under a Facebook environment. Different studies have examined different multimedia tools and applications for teaching and learning. For example(Kolb & Kolb, 2005) present a different theoretical framework called

learning space where they use the Facebook platform as an interface between the student and the teacher. Also (Jong, Lai, Hsia, Lin, & Liao, 2014). Also (Jong, Lai, Hsia, Lin, & Liao, 2014) in their research work show us an exploration about the different educational potentialities of the Facebook platform. In that work, they were interviewed by the number of attendees which made comments about the different experiences in the use of Facebook. Also (Shiu, Fong, & Lam, 2010) in their paper shows a study of how the social network Facebook can be driving courses electronically. In this experiment, they showed some tools of the social network Facebook being used for asynchronous and synchronous communication and also, they explain how Facebook can be used in a very different and efficient way. Finally, the experiment emphasizes the use of Facebook as a framework which provides free of charge software to be used in a traditional way of learning.

Even do, there are some experiments that explore the different ways to handle the virtual network of Facebook in an educational circumstance, still more experimentation is necessary to find a precise factual environment that can be fit into the experimental framework steadily. Unfortunately, there is not the luxury of time. We have students waiting for our resources.

3.4 The learning of Physical Sciences Under Facebook Setting

Regarding the research of teaching physics under the parameters of Facebook, we can see that is very minimal; it is very limited. The research that has been generated about it lack of factual

elements that we could considering them with rigorous character for their application under the new curriculum format. I still see a lot of uncertainty about the teaching physics subjects virtually. For example, some of my talks with my colleges in the department of physics, have experienced a dislike about the teaching of this subject in a virtual manner. I tried to inquire about why this kind of lag but not many responses were generated. Most of them, could say, that the most important thing is the way how scientists see the need of teaching physics, which is, for most physics teachers in their mind, we can find the traditional concept of education through lecturing and supplemented by laboratory practice. Many cases, most teachers agree on if we could integrate the first part of teaching physics virtually online and then students, physically, make physical phenomena experientially. It could be a responsible approach that many teachers could support (Freedman, 1996).

This gap about virtual laboratories was the crunch for the advancement of physics in a virtual manner. Despite this, there are investigation lines experimenting on the effects of this dynamic using physics equipment in a virtual manner. For example (Finkelstein et al., 2005) discuss his work in which he performed an experiment with two groups of students who use tools for teaching physics in a virtual manner and the other group used traditional techniques Laboratories. Final conclusions of this work vary. He mentioned that student's team who used the simulator somehow coordinating conceptualize the practice differently but it also tells us that, the points could be accentuated in an instrumental way. His experiment has to be follow by other researchers.

Despite the potential of the risk of this line of research and apart from the challenges involved in this line of research, the experiment was of great relevance to me. Regrettably, research on the line using Facebook as a virtual platform for teaching physics -specifically- could say that there was almost null as mentioned above. Hopefully, this effort represents the work of the pattern so that some researchers are interested in` this investigation line and in the future, we could see more projects involving the teaching of physics in a virtual manner by taking advantage of technological tools currently offered by the internet.

Despite many attempts by the academic community to find different ways to teach physics, we can see that the United States maintains a traditional form of teaching physics: lectures, discussion sessions, and laboratories (Bonwell& Eison, 1991).At this point, I want to emphasize something very important that has been my personal experience about how to teach physics. Physics teachers tend to give more importance to research by itself than the academic act of teaching; I mean, the way many teachers teach is closely linked exploration and has many similarities with scientific research, in other words the scientific method and research as a very popular way to teach physics in the classroom. How can you help your students learn science better and more efficiently in a different context? Although there is no universal way to teach, experience shows that some general principles apply (*Science Teaching Reconsidered*, 1997).

Having a totally different context diverging away from this framework that we've been handled for many years, we can introduce a new generation of contemporary students; these are already in classrooms and in addition, they tend to reflect different learning characteristics oblivious the theoretical framework handled to traditional students. Undoubtedly, such students need to

learn differently so it is important to bring your theoretical framework the close the gap and can align their unique learning characteristics.

Although the teaching of physics through Facebook is almost zero, we could make some reference from works that although they have not been designed for teaching physics they have generated some resources for science. In particular, *Facebook* appears to provide a ready space where the 'role conflict' that students often experience in their relationships with university science work (Selwyn, 2009).

Abu-Alruz, (2014) postulate that participation in online Facebook learning activities to communicate with their classmates and the instructor for educational purposes, such as inquiring about course requirements, including course syllabus, exam dates, assignments, and for project requirements. In order to get these skill, Alhzmi and Rahman (2013) suggest supporting science classes with the interactive and collaborative features from Facebook.

3.5 Photovoltaic theory, principles and methods

Learning photovoltaic theory (PV) has not been of great relevance among engineering and science students until today. Its significance in their study is due to the implementation of renewable energy and the development of elements of non-traditional industrialized energy in recent times. This will emphasize that certain physical concepts, such as the teaching of the PV theory is intended to be taught from other non-traditional point of view we are used to study the physical science. According with (Ghosh, Fishman, & Feng, 1980) the study of the PV

theory in universities obey to the development of an industry in which has a potential to generate a new generation of power source at an industrial level. Therefore, the development of photovoltaic theory within physics curriculum had been increasing in an impressive manner. So right now, we can see different frameworks for the teaching this theory. For instance in their experiment, (Schauer, Ožvoldová, & Lustig, 2009) proposes the teaching of photovoltaic theory through a system of distance learning called INTe-L. For this, they departed from a scientific base oriented in the materials of science and electronics theories. The remote experiment could be observed under this link (http://kdt-4.karlov.mff.cuni.cz/fotodioda.html). One of the concluding observations in describing how students were interested in learning this photovoltaic theory due to the potential of this subject intended for the raising power industry right now.

The teaching of photovoltaic theory is not a new line of research. There are different documents that indicate that there are efforts of more than 30 years of antiquity. For example, in the case of Lowe (1975) is interesting see the effort that the academic researchers have been trying to allocate a better framework for the learning of the PV theory since two decades ago. In this case, they propose the use of problems of the everyday world to motivate students to master basic physical principle of the PV Theory.

Currently, there are a great variety of attempts to find the best way to teach this specific subject, in some cases in a very particular way. For example, the work of Freeman et al. (2012), he developed a total virtual laboratory for the study of the PV Theory. He mentions that remote triggered laboratories are an excellent way to provide access to costly labs and equipment for students in areas without such facilities. This experiment enables the student to learn in a hands-

on, practical way about the fundamental characteristics of photovoltaic solar cells. This experiment has been hosted on our Virtual Labs website for over a year, with a large number of students using the site. Base on some experiences from different experiments developed by several researches, we decide that for this experiment will be required to work with the theoretical elements aims to the PV theory(Freeman et al., 2012).

The context of the course that students will be taken by laid into the category for requirements to fulfill the curriculum of general education. This mean that the course could be taught in a lecture setup procedure. In other words, no lab required. There are existing courses developed to fulfilling the requirements of the theoretical curricular part requirements for accumulation of credits toward the earning of a degree. But also, students must be support the granting of credits with the taking of laboratory classes that are design to fulfill the practical part for the degree they are seeking. Most of the time lab classes are offer to fulfill the requirements degrees in sciences.

For this study, the learning of the PV Theory in the Facebook virtual environment, has been set up a serial of subjects related to the PV Theory. The academic curriculum was modified to cover the learning of the PV theory in a virtual way under the virtual platform of Facebook. Although the curriculum has been re-formulated; the topics to be developed from virtual tide were chosen under the features and potential of being embedded under the categories of Facebook tools. At the end, the subjects to be covered required by the curriculum were not modified or excluded; the class core remain intact. For this purpose, the teaching of curriculum in the social network of Facebook was introduced as follows.

Exploring the capacity of Facebook to generate a real worthy environment to sustain a lecture of the photovoltaic theory has been an interesting fact. The lack of straight examples has been an issue to overcome. Cue to this constrain the modeling of this experiment were constructed in a combination of different approaches develop among some authors. For example the experiment executed by (McKagan, Handley, Perkins, & Wieman, 2009) explain how was developed a curriculum on the photovoltaic theory aided with computer simulation. In this experiment shows and explain some interesting approach about the virtual interactive lectures with peer to peer instruction and mathematical homework problems.

On fig XXX is show an example of this setup for virtual instruction of the photovoltaic effect simulation.

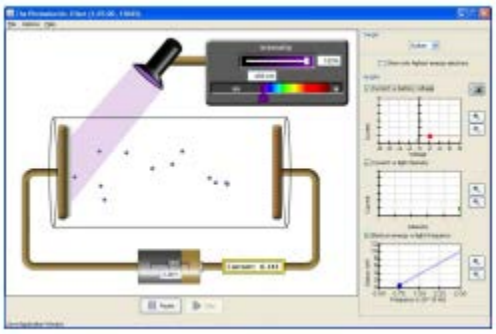

Fig. 2: The photovoltaic Effect. Simulation

Another interesting approach to be blended into our experiment were the one created by (Wieman, Adams, & Perkins, 2008). In this experiment, the author exposed a series of physical experiment from a virtually experimentation side. In this experiment, the use of a virtual technology called (PhET) Physics Education Technology is exposed. For this, the author claimed that visualization of phenomenology through a virtual platform is a magnificent way

of learning. Also, the author reveals some outstanding results in the collection of grades and responded of student under the perspective of motivation.

First, justifying the learning approach we said that it was written to address several audiences: college students of different majors who desire an introduction to the field of photovoltaics, students interested in PV science and technology, and end users who require a basic understanding of theory to supplement their applications.

Probably the most influential model to teach the photovoltaic effect over Facebook was the one called digital story telling developed by (Sweeney-Burt, 2014) but in a virtual way were showing by (Kotluk & Kocakaya, 2016) years later. In this approach, we found the necessaries paths to conceive our curricular setup of Facebook academically. This framework claim that is capable of creating a classroom environment virtually, allowing the students to be active learners, creating communities, fostering communication as well as providing students with technology literacy (Karakoyun, 2014).

For Hersch and Zweibel (1982) the photovoltaic (PV) effect is the basis of the conversion of light to electricity in photovoltaic, or solar, cells. Described simply, the PV effect is as follows: Light, which is pure energy, enters a PV cell and imparts enough energy to some electrons (negatively charged atomic particles) to free them. A built-in-potential barrier in the cell acts on these electrons to produce a voltage (the so-called photovoltage), which can be used to drive a current through a circuit. This description does not raise the complexity of the physical processes involved (Hersch & Zweibel, 1982). Although it is impossible here to cover fully all

the phenomena that contribute to a PV-generated current, it is possible to go deeply enough into these phenomena to understand how an effective cell works and how its performance can be optimized (Hersch & Zweibel, 1982).

The arrangement of this topic to be implemented in the platform was analyzed in a certain way to be able to align and summarize it. This in order that its content is relevant and does not lose any of its curricular objectives when it is covered in a way synthesized in the platform. We must remember that although social platforms pretend to be of great potential to communicate, we must also understand that there is no rivalry of these with spoken language. That is, Facebook's social network has limitations on communication. These limitations are very important for the development of very abstract concepts. For example, in a normal class to be covered such subjects the potential for questions to exist would be very high That is why for this work, how to implement the teaching of photovoltaic theory on the Facebook platform was done in a way to answer the potential of questions that could bring these types of topics. We can do this by answering some fundamental questions about processes central to the working of a PV cell:

1. What does it mean to say that an electron is freed?
    a. Where is it freed from?
    b. Where does it go?
2. What is the potential barrier that acts on the free electrons?
    a. How is it formed?
    b. What does it do?
3. Once acted on by the potential barrier, how do the free charges produce a current?

This elementary Physics course covers the basic history concepts and principles of physics. This course will give to students the basic fundamental of physics topics -mechanics, heat, light, sound, electricity, magnetism, and modern physics.

The principal outcomes for the course are frame as follow:

1. Assess the role of science, and in particular, physics, in helping us to better understand the complex, technological society of which we are a part.
2. Trace the history of physics and the evolution of scientific thought from ancient to modern times.
3. Define and analyze the concepts of velocity, acceleration, force, inertia, mass, work, energy (kinetic, potential, etc.) momentum (linear and angular), gravity, tides, power, pressure, density, temperature, thermal expansion, heat, specific heat capacity, waves, sound, electric charge, current, magnetism, electromagnetic waves (including light), photons, and radioactivity.
4. Discuss the various types of motion, Newton's Laws (including his Universal Law of Gravitation), the conservation laws of physics, the laws of electricity (e.g. Coulomb's and Ohm's Laws) and magnetism. The properties of waves (viz. sound and electromagnetic, including light) and the basic principles of atomic and nuclear physics, relativity and quantum theory.
5. Solve a variety of basic problems in particle kinematics (uniform motion and accelerated motion including "free fall"), dynamics using Newton's Laws of Motion and the conservation laws of energy and momentum (e.g. collisions), fluid mechanics (including Archimedes' and Bernoulli's Principles), thermodynamics, wave motion, basic electricity (Coulomb's and Ohm's Laws), and radioactive decay.
6. Interpret the results of simple experiments and demonstrations of physical principles.

Fig 3. Curriculum outcome.

For this experiment the chosen topic to be analyzed was the one belongs to the topic of Atomic Physics.

Topic venue	Subject. Chapter 7. Atomic Physics
a.	Blackbody Radiation.
b.	Quantum Hypothesis.
c.	Photovoltaic Effect
d.	Atomic Spectra.
e.	Borh Model of the Atom
f.	Atomic Structure

Fig 4. List of subjects to be covered by the chapter.

College textbook used for this experiment was "College Physics" by (Giambattista, Richardson, & Richardson-McCarthy, 2006). Thought subjects were extracted from this textbook version. The introductory topic of the photovoltaic theory covered by the textbook were really superficial. In my personal point of view, I believe that the reference of the theory by the textbook lack of elements that could support a quality understanding of the topic. The development of the topic is exposed by the textbook in the following way.

1 Development of the Photovoltaic theory context

27.3 THE PHOTOELECTRIC EFFECT

Photoelectric effect: EM radiation supplies the energy to remove electrons from a metal.

In 1886 and 1887, Heinrich Hertz did experiments that confirmed Maxwell's classical theory of electromagnetic waves. In the course of these experiments, Hertz discovered the effect that Einstein later used to introduce the *quantum* theory of EM waves. Hertz produced sparks between two metal knobs by applying a large potential difference. He noticed that when the knobs were exposed to ultraviolet light, the sparks became stronger. He had discovered the **photoelectric effect** in which EM radiation incident on a metal surface causes electrons to be ejected from a metal.

Later experiments by another German physicist, Philipp von Lenard (1862–1947), found results that were puzzling in the framework of classical physics and were first explained by Einstein in 1905. Figure 27.4 shows an apparatus similar to one invented by Lenard to study the photoelectric effect. EM radiation (visible light or UV) falls on the metal plate; some of the emitted electrons make their way to the collecting wire, which completes the circuit.

An applied potential difference holds the collecting wire at a lower potential than the plate so that electrons lose kinetic energy as they move from the plate to the wire. The larger the potential difference, the smaller the number of electrons with enough kinetic energy to complete the circuit. The **stopping potential** V_s is the magnitude of the potential difference that stops even the most energetic electrons. Therefore, the maximum kinetic energy of the electrons is equal to the increase in potential energy for an electron moving through a potential difference $-V_s$:

$$K_{max} = q\,\Delta V = (-e) \times (-V_s) = eV_s \qquad (27\text{-}2)$$

Fig. 5 Book exertion 1.

2 Phenomenology explanation by a practical application

Experimental Results

The photoelectric effect itself seems reasonable according to classical physics: the EM wave supplies the energy needed by the electrons to break free from the metal. However, several *details* of the photoelectric effect were puzzling.

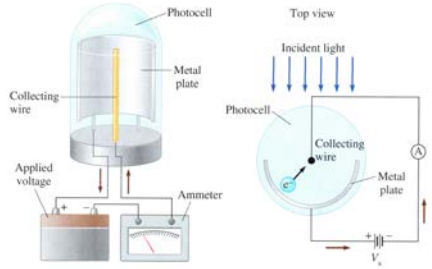

Figure 27.4 Apparatus used to study the photoelectric effect. A photocell is made by enclosing a metal plate and a collecting wire in an evacuated glass tube. EM radiation (visible light or UV) falls on the metal plate; some of the emitted electrons make their way to the collecting wire, which completes the circuit. An ammeter measures the current in the circuit and thus the number of electrons per second that move from the plate to the collecting wire. An applied potential difference holds the collecting wire at a lower potential than the plate so that electrons lose kinetic energy as they move from the plate to the wire.

Fig. 6 Book exertion 2.

3 Didactic of the Photon dynamics

The Photon

Planck's explanation of blackbody radiation said that the possible energies of the oscillating charges in matter are quantized; the energy of an oscillator at frequency f can only have the values $E = nhf$, where n is an integer and

$$h = 6.626 \times 10^{-34}\ \text{J·s} \qquad (27\text{-}3)$$

In 1905, the same year that he published his special theory of relativity, Einstein explained the photoelectric effect and correctly predicted the results of some experiments that had not yet been performed. Einstein said that *EM radiation itself* is quantized. The quantum of EM radiation—that is, the smallest indivisible unit—is now called the **photon**. The energy of a photon of EM radiation with frequency f is

$$E = hf \qquad (27\text{-}4)$$

According to Einstein, the reason a blackbody can only emit or absorb energy in integral multiples of hf is because the EM radiation emitted or absorbed by a blackbody is itself quantized. A blackbody can emit or absorb only a whole number of photons.

The key to understanding the photoelectric effect is that the electron has to absorb a whole photon (Fig. 27.6); it cannot absorb a fraction of a photon's energy. The energy of a photon is proportional to frequency; thus, the photon theory explains the frequency dependence in the photoelectric effect that had mystified scientists.

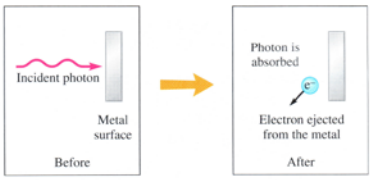

Fig. 7 Book exertion 3.

4 The effect of the Electron-Volt

The Electron-Volt

The energies of the photons in Examples 27.1 and 27.2 are small compared with energies of macroscopic bodies, so it is often convenient to express them in electron-volts (symbol eV) rather than in joules. One electron-volt is equal to the kinetic energy that a particle with charge $\pm e$ (e.g., an electron or a proton) gains when it is accelerated through a potential difference of magnitude 1 V. Since 1 V = 1 J/C and $e = 1.60 \times 10^{-19}$ C, the conversion between electron-volts and joules is

$$1\ \text{eV} = e \times 1\ \text{V} = 1.60 \times 10^{-19}\ \text{C} \times 1\ \text{J/C} = 1.60 \times 10^{-19}\ \text{J} \qquad (27\text{-}5)$$

For larger amounts of energy, keV represents kilo-electron-volts (10^3 eV) and MeV represents mega-electron-volts (10^6 eV). The photon of red light in Example 27.1 has energy 1.9 eV; the x-ray photon has energy 41 keV.

When finding the energy of a photon given its wavelength (or vice versa) using $E = hc/\lambda$, the energy of a photon is often expressed in electron-volts (eV) and wavelengths are often stated in nanometers (nm). For this reason, it is useful to express the constant hc in units of eV·nm:

$$h = \frac{6.626 \times 10^{-34}\ \text{J·s}}{1.602 \times 10^{-19}\ \text{J/eV}} = 4.136 \times 10^{-15}\ \text{eV·s}$$

$$c = 2.998 \times 10^{8}\ \text{m/s} \times 10^{9}\ \text{nm/m} = 2.998 \times 10^{17}\ \text{nm/s}$$

$$hc = 4.136 \times 10^{-15}\ \text{eV·s} \times 2.998 \times 10^{17}\ \text{nm/s} = 1240\ \text{eV·nm} \qquad (27\text{-}6)$$

Fig. 3 Book exertion 4.

5 Future work.

Now, setting up the material to be carried by Facebook we constrain with two elements unseen elements. The first one, flexibility of the curriculum. The benefit of teaching material that coming from a specified curriculum is a hard topic, Due to the school's educational specification and school policies the deviation on the curricular activities lack of flexibility. That means that options to be wider or condensing the matter of the subject are minimal. Exist some procedures for accomplish that kind of actions. Unfortunately, this is a very tedious effort. At the end, the teaching on the subject are supported by the instructor discretion. The only requirement is maintaining the structural main-topic curricular objectives in the way of supporting required outcomes and there is no problem. The second constrain to corroborate with the integration of the curriculum into the atmosphere of Facebook is the copyright issue. Infringe the intellectual property is one on the major problems that the education industry is facing at current times. Governments are bigly supportive to account the concept of copyright laws. Also, the government of the US have a special enforcement office that is in charge of persecute possible cases of law infringement on intellectual properties. Here is more, the school where I used to work, the one where this experiment where executed has no open eyes in the idea of using external intellectual property mixed with its own. At the time of the decision regard the textbook, I had planned for using in this experiment, author of the respective intellectual property, they were informed (at least trying to contact them) about the willing of using their ideas for an experiment. The response was null. As I addressed previously, I had not the luxury of time, I did decide to go further with the experiment with a different open copyright material to cover the lecture of the Photovoltaic Theory for the experiment.

Theoretical elements with a great potential -I believe that better that the book material- were found over the internet. They were used for the setup of the lecture.

Curriculum recommendations are very simple steps that help us to fulfill curricular requirement under the school protocols. For this experiment the way to teach the subject -the traditional way was recommended. The means under the experience of curriculum developers was the best way to teach these topics because we will use the influence of our school educational structure. The applied methodology, must include elements in the order of lecturing, discussion, and slide presentation. As we recall, these elements have been questioning for the insufficiency capacity of motivate students as well as the lack properties for creating a proper learning environment no just to the new students but also in a traditional class setup -peer to peer classes. At this point the importance of educational methodologies into a virtualization facade is a fact. For this experiment, I followed the required means of methodology but just in a different environment -the virtual environment.

The preparation of the theme of theory. The Dynamic in the social network of Facebook was done as follows:

Only tools typical of the Facebook platform were used, that is, no additions were made to extra applications that can be added to the Facebook platform. Facebook counts with some tools that will empower the supporting of elements required by curricular instruction methodologies -lecturing, discussion and graphical interventions. To satisfy required methodologies in the order of lecturing, we utilized two proper tools from Facebook. The first one give the opportunity of an extended are for the publishing of date in a combination with graphical

representation. Believing that the major asset of this tool is the instant synchrony communications that offer to students, and moreover, this specific tool is the only one tool that appear by default in all mobile Facebook platform on the different existing commercial platform. So, student won't get any confusion at the time of using the Facebook platform on their mobile devices no matter what is the origin of it. The second tool from Facebook that was used for lecturing is notes tool. This tool is able to hold a small 145 characters. This tool was used for special instruction that students must follow before they continue with the discussion part after lecturing.

For the discussion of the lecture -action that had been require for curricular compliance- the tool that support a supportive and strong discussion forum was the Facebook "wall". The characteristics of this Facebook's wall" allowed students being in contact communication with all student at the same time. This is, instructions given to participate on the discussion of the topic review was mandatory. Replays from student were demanded. This action were instantaneous messages among the class -50 people being communicated and replying back and forth at the same time. The potentiality of this tool, such as carrying graphics, videos, pictures etc. is without no doubt the major asset of Facebook, even do, it is used socially or educationally.

Another used tool from Facebook that were used in the experiment was the use of Videos Tool. As a result of the need of using graphical aid, the videos tool will support the carrying of videos for viewing by students. The potential of this tool is very big. This tool has the capacity of support videos to be streaming by the user of Facebook in a very low streaming bandwidth

capable of being reached by all the member of the group. The approach worked here was the one that a small open source video was required to support the lecture given previously.

Having in consideration that Facebook has the capacity of work with a variety line of tools, for this experiment we just considering the usage of proper tools. This is, we leave out the possibility of experiment with paid-to use tool. As we discover, Facebook have a huge community dedicated to the development of tools that can be used to enhancing the Facebook experience. Most of the developer claim that developed tool is in the range of comply with a better experience at the time to be combine whit the usage of Facebook. Although there were a lot of application with a specific educational use, the aim of this experiment is the identification of the virtual environment that Facebook by itself offers for the academic community.

The first step includes an introduction that was disseminated among all members of the class. The following figure shows the first unproductive approach to photovoltaic theory on the Facebook platform.

Fig. 9 Introduction to the course.

The following figure is shown in the introductory part of the photovoltaic theory on the Facebook platform.

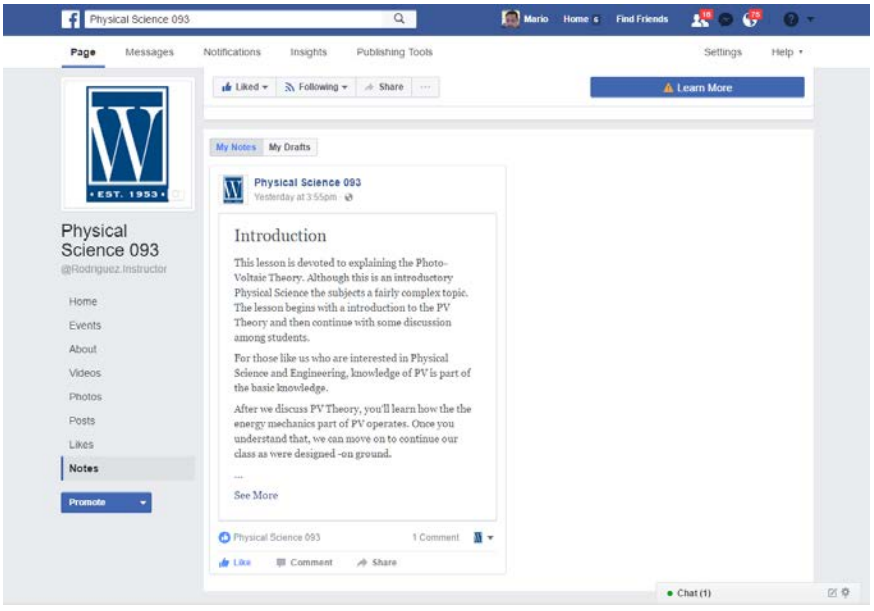

Fig. 10 Facebook Introduction class section.

The following figure shows the number one part of the practice. The theoretical part.

Fig.11 Facebook Theoretical section.

The following figure shows the second complementary theoretical part. This shows a video in which the theoretical part is shown in a graphical way.

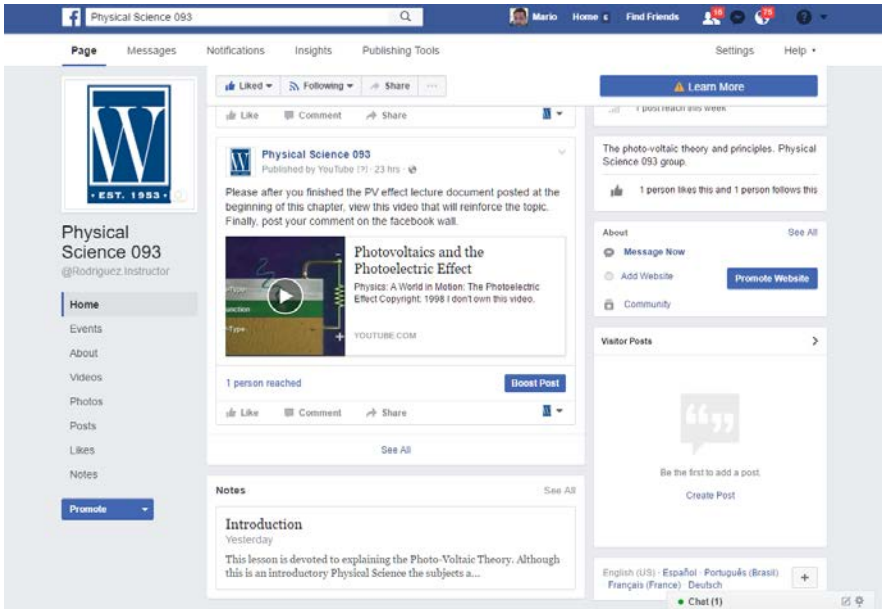

Fig.12 Facebook Class Video Section.

Fig.13 Facebook Feedback Section

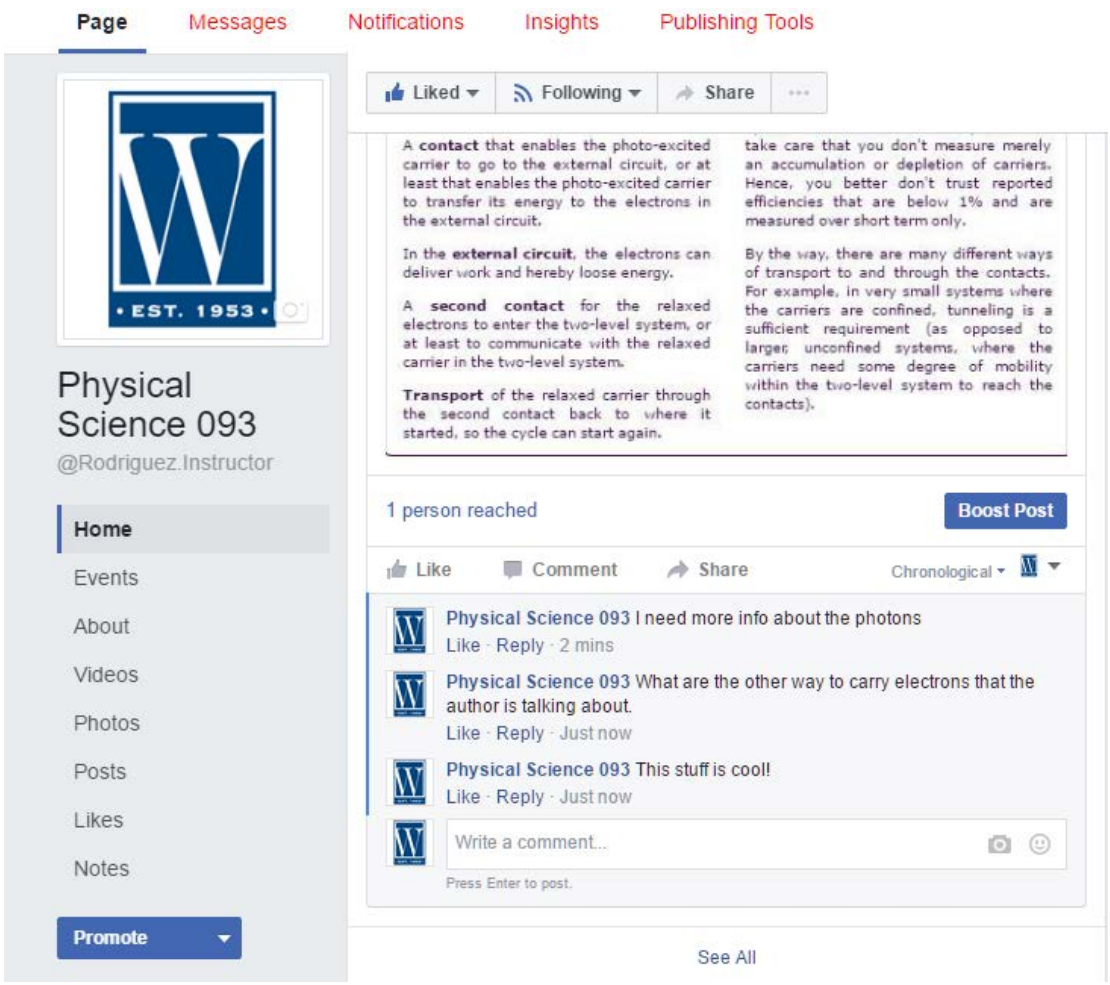

Fig. 14 Facebook Wall Section.

Chapter 4: Methodology

This chapter is divided into three sections which describe the methodology followed in the research project. We begin with an introduction to the taken approach. Section two describes how the case study was the fitted for the design of this experiment. Section 3 explains the context of the students who participated in the study. Also, it explains how the surveys were structured and the previous tests that went on to become the final versions of the surveys that were used for data collection.

4.1. Introduction to the research methodologies

Research results depending as much as the quality of the design tools used in data collection. This is why the methodology used in the preparation of an investigation must be designed in a way that helps in the analysis and interpretation of results. It is important that the design of the methodological tool focus on the investigation of the research questions. That is, the methodological tool will focus on answering the research questions in a straightforward manner. This action will lead to an early interpretation of results and in some dimension to forecasting results. According with (Altmann, 1974) that also mentioned:

"The phenomena we wish to see should affect our choice of method, and the choice of method, in turn, affect what we can see."

The clear interpretation of the result of an investigation depends, in some degree, to the quality of variables that has been set up for the experiment.

4.2 The Case Study

For this experiment, it is presumed that a qualitative research will lead us to the finding of student's conceptions regards the use of Facebook as virtual platform that enhance the learning of Physical Science. Also, the descriptive approach of this research will perceive and construct the instrumental schemes developed by students at the time to be expose to the use of Facebook in an academic fashion

Case of study research is a “practical” approach in the sense that the researcher is obligated to use all methods possible to address a research problem. It is also “practical” because individuals tend to solve problems using both numbers and words, combining inductive and deductive thinking, and employ skills in observing people as well as recording behavior. It is natural for individuals to employ mixed methods research as a preferred mode for understanding the world.

The case of study will cope these two characteristics in the fashion that steps will portrait elements enriching the findings. So, without any doubt, this method carries all necessary elements to satisfy the approach named by Onwuegbuzie prior mentioned.

4.3 Student Demographics

For this study, we had the participation of two groups of freshmen college students. For these students, it was required at least two science courses to fulfill the requirements of their academic line where they are involved now. The first group consisted of 25 students in which 60% was in the position to take credit courses for advanced engineering. In the other group was only 25 students of humanities educational area.

4.4 Survey

The experiment began with the approval of all students enrolled in physics courses, which are present consent to perform the experiment in the course of the class. After all students understand the consent, I gave them a questionnaire, which should be filled on the first day of the class. In this questionnaire, we administered the inquiry on the use of Facebook. This questionnaire inquired questions about the demographic situation, the use of technology

aspects of motivation in school and to what extent they were interested in participating in this experiment. With this questionnaire, students had a basic understanding of the expectations of students about the class, especially with this experiment on the use of Facebook.

4.3.2 Survey Question Development

Inquiring about the use of Facebook, we found the work of (Hargittai & Hsieh, 2010) which shows us the lack of exploration about the use of Facebook and the use of the internet for academic purposes. This has caused a setback in the development of the conceptual framework of teaching of the new contemporary students.

Following the example of the work of Hernández, Fernández and Batista (2010), a vocal group of 3 to 10 people were identified to perform a group interview, in which participants identify their environment and guide the dynamics of the interview. For this experiment and following the guidance of Hernández, Fernández and Batista (2010), we decide to involucrate some department faculty for the design of the questionnaires. This approach will lead us to indagate the perfect environment of a Facebook page under an academic point of view. In order to structure the questionnaire for the interview, an inquiry was made with several physics professors, explaining the purpose of the experiment. It was proposed to generate a series of relevant questions to induce the use of Facebook in an academic environment and its complications. The form can be found in appendix 1A.

For this work, we created questionnaires for the investigation of Facebook under many angles as a social network also, its relation with the internet for its use in an academic way. Many of the questions are shed from some earlier work done under the basis of (O'Brien, 2012).

4.3.3 El uso de internet y su uso general en el internet

In the work developed by Lenhart, Purcell, Smith y Zickuhr (2010), the use of Facebook as a social network encourages the use of the internet. For example, through a telephone survey, the author shows us how there is a significant trend in the use of the internet among students of the school compared to those who have no social network. In addition, the authors rectify that the social network of Facebook generates that the young people connect to the network more often. It also justifies this (David, 2010) indicating that Facebook is the most famous online social network.

Reports from the academic community tell us that they do not have enough evidence to report that users of the social network Facebook have used it for another reason than social networking. To find data that lead us to inquire about the purpose of using Facebook a questionnaire was conducted; this inquiries about the context of use of this social network.

Moreover, Likert scale is one of the most usable qualitative technique available for research in social sciences. Likert scale popularity is presuming that been generated by the flexural availability of this research tool offers. In some cases, external influences are adding value to outputs generated by given answers. External environments is a factor that could be essential to obtains factual value reports from a Likert Scale inquiries (Dawes, 2012). Numerous experiments have been recall that the design of Likert scales to be use as a collecting information technique are, in some fashion, an issue that must be externally influenced by a conceptual introduction before the Likert scale patricians start participating. This is, conceptual inquiries are a natural process in which participants are exposed to some kind of external pressure-related factors that in some how these are constituents of the final participant output. The kind of external influencers are declared in the order of transitional facts. This means that

commonly Likert scale participants are expose to an environment of lack of context. At the beginning of the process of answering the Likert scale, participants most like are blind to the context in which the Likert scale designer developed the inquiring process. It is necessary that participants take some necessary extra steps to being aware of the context that must be required in order to experience a better conceptual development necessary for an optimal Likert scale output.

In this experiment, as it been mentioned previously, the Likert scale's inquiring section core are constituted by three sections that have the purpose of recovering conceptual scenarios as well as the extraction of instrumental genesis theoretical elements; it has the need to be extended. Therefore, the need of organizing a preamble to approximate student into the required context was a need to be addressed. This will aid the inquiry section of the Likert scale to be closely factual, as we desire. Supplemental Questionnaires in the order of inquiring the relationship among the internet, Facebook and technology were developed. These questionnaires will bring up the contextual preamble need it for the recall of an enhanced conceptual inquiring.

Approximating questionnaires will be given to participants to be answered. The questionnaires will be exposing the preferences from students in the ambit of Internet usage habits, Facebook usage habits and technology preferences.

4.3.4 Internet use in the classroom

Several documents provide us with data on internet use in the classroom. For example in the work of (Smith, Salaway, & Borreson Caruso, 2009), 26% of students at American universities went online for nonacademic reasons during the class. More recent work, (Lenhart, Purcell,

Smith, & Zickuhr, 2010) reveals some more congruent data about the use of the internet in the classroom. In their results, they report that 32% of the students in the first year of the school agree with the use of the internet in the classroom. According to (Lenhart et al., 2010) the figures of Internet use have reached 81% in the students of the school, in their results shows a tendency in the use of the internet due to the use of smartphones among students. These works inspired the inclusion of questions about the use of the Internet by the students during the classes in the questionnaire of this research.

4.3.5 Pilot survey

The proposal for the resolution, of this first research question, is based on the following: to considerer the participation of at least 50 students in an elementary physics college class. At first, it was intended to have a more significant group of students sample but according to the regulations of the College Programs Accreditation Agencies, a minimum number of Students for a physics class is 20 with a maximum of 30 -in a college classroom. This have been adopted by the school. The school, at this time, were under the supervision of Western College Association. Most of the institutions are controlled by these types of agencies in the United States. These agencies have the function of standardize the education and determine the necessary quota of students to carry the curriculum at an appropriate level. Universities and colleges must follow regulations to conserver accreditation.

Returning to the point, the experiment will hold a maximum group of 25 students from the physics class; this is the way that the ground class of physics is been run by a physics instructor traditionally at the school. In this class. The instructor will be provided with technological tools such as the Internet, which will be integrated into the virtual platform Facebook. The course is scheduled to be instructed for 16 weeks and this will be carried out in the fall of 2015. During the course, students will be informed about various social networks and Web 3.0 tools.

As an initiative to break the ice for the course, I will be asked to students who participates in the design of the power class through the Facebook platform. The first inquiry for students' participation will be one in which they are under consideration to propose a model of teaching through the Facebook platform (preamble section). The following inquiry section will be the one for collecting factual conventional thoughts about the potential of Facebook to being used as a virtual platform enhancing the learning experience of a Physics class. To end, students will be divulging their experiences after being exposed to the use of Facebook academically as well as disclosing possible Instrumental genesis element generated during the experience.

4.3.6 Methodology for first research question (proposal)

Questionnaires can be define simple as a written interview ("Questionnaires | Simply Psychology," n.d.). Probably one of the most followed methodology used on research due to its easy implementation and the quick way to obtaining data. For example, data could be collected at any time. There is no need that the researcher been present for this act.

For this exercise, close questions approach was used. With this, I will able to gather focus to the point of students answering in a more related way.

I will push students to answer specific question in a Likert scale of five points of agree or disagree level.

Closed question questionnaires usually provide ordinary data, but in this case, I will reroute inquiring to the measure of strengthen attitude by the aid of the rating scale.

Likert scale have the advantage of do not accept simple yes/no answer, but rather allow degrees of opinion ("Likert Scale | Simply Psychology," n.d.). The analysis of data will summarize using the median or a mode for the easiest interpretation of the data –conceptions of students. Assuming that the strength/intensity of experience is linear I will assure that the measurement of the attitudes related to the use of Facebook can be related to the answer of the first research questions.

For this step of the experiment, a close question methodology will be applied. The first question has the responsibility of finding the perception of the use of Facebook academically. For this, the accomplishment must carry out the inquiring of probing or disapproving the model in which students can learn over the Facebook platform. Moreover, it is important understand how students are using the social network Facebook for academic purposes. The most effective way to inquire about Facebook conceptions in the academic aspect is start students exercising on it (Grosseck et al., 2011).

The instrument used in this survey will be a questionnaire. In the first part of this questionnaire, I will ask the student his/her gender and demographic information. The second part of the questionnaire consists of interrogating students about their practices on the Facebook platform –approximating questions. Here will be 10 questions in which the getting of conceptions

enables students and their perception for the use of Facebook with an academic purpose. For more questions proposed approach see Appendix 1.

With this questionnaire, I will pretend to interrogate participants about the general usage of the internet as well as the usage of the Facebook for general and academic purposes. This approach will be generating information that is related to the conception of how the students perceive the use of the virtual platform of Facebook in a different way as it was intended priory. There is a division of questions intended in the purpose of two meanings. The first one is evocated with the intention of look around the perspective of the use of the internet in the academic world. As we recall by (Lenhart et al., 2010) in their job, students been exposed to the internet at the time of the scholastic activities tend to be distracted from the purpose of their exposure. In some occasions the notion of being in could be no differentiated. Thus, students are practically expose all time to the internet. At the time of the class, at work, and home. They can be existing on both sides without the specific meaning.

The purpose of the second part is mark a line between the use of Facebook and the use of the internet. It is important for them and for the result of the experiment that they understand the marked line. The division of questionnaires were provoked for the differentiation of answers. The student must understand the difference of being on Facebook under an academic purpose and the other side, the participation over the internet on a general fashion.

For this construction of knowledge aims to use the scale of 5 levels Likert. To learn more about the five levels of Likert see Appendix number two.

4.3.7 Methodology for second research question (proposal)

We can define observations simply as watching people ("Observation Methods in Research | Simply Psychology," n.d.). Observations would see more than a simple view. For this experiment, I propose a very simple methodology called "simple observations", Observations are relatively simple to carry out. They can be control it easily and very often they can be very time consuming.

The naturalistic observation involve the spontaneous behavior of participants in natural surroundings, The researcher simple records what they see in whatever way they can ("Observation Methods in Research | Simply Psychology," n.d.).We use the following approach to develop answers for the research question number two, which is identified as inquiring about instrumentation's parameters that could happen with Facebook in contemporary students. Seeking elements that could drive us to the perception of a self-induced instrumentation's elements by the usage of Facebook or could be that the contemporaneous students have developed a unique technique that does ignore technology, much less the use of Facebook? In other words, the use of technology will be part of the contemporary students or not.

They are several strengths about the use of this method for collecting data. I will be able to collect information in its own flow of behavior. This is that observations will be made at the point of being generated. Due to the nature of the framework (Instrumental Genesis) is necessary the seeking of elements on their own environment. In addition, another important strength of this method is the capability of generation new ideas. This specific method could

give the researcher the ability of study the total scenario. In this way, researcher is exposing to a new venue that probably were not expose at the time when the experiment was designed. Again, the use of this new developing framework has the need of have a better scenario for observations. Instrumental schemes are difficult to observe, so in this way, the use of this method will be great for the seeking of these type of elements.

As is propose by (Guba, 1978), this methodology offers alternative strategies for problems when the experimental approach is implausible. Discovering instrumental schemes will be the work of this methodology.

4.3.8 Methodology for third research question (proposal)

An addition to answer research question 3 was taken. For this question, a structure called open questions were followed. Open question allow people to express how they think in their own words ("Questionnaires | Simply Psychology," n.d.). This type of approach will expand the data to the level of being able to collect information in as much detail as we like to see. Expressing satisfaction regard the use of Facebook in academic way is not a simple task. For this, it is important to have a clear idea of the satisfaction on terms for the using of Facebook. Expressing ideas more openly is a characteristic of this kind of approach. Open question often is used to answer complex questions. The vision for the third research question opens up the opportunity to indagate regards the experience of learning induced by the use of Facebook as a learning tool; expressing satisfaction cannot be answer in a few simple Likert categories. Modeling a better idea of student's conception about the use of this artefact as learning tool

requires more detail. Additional open question section to overview conceptions was indeed need it.

3.4 Vision

Searching for answers these research questions is certainly not a simple task. There are different obstacles that have to be examined how they affect the experiment; in this way, we were able to find the most suitable solutions to avoid the possible setbacks of this experiment. For example, we can understand that the search for concrete answers can be varied by ethical elements. These could interfere with the students' response. Although, we know that the questionnaires are very good for inquiring relative issues, we know that these questionnaires are applied to people who in some cases could not be honest. For example (Bordens & Abbott, 2002) comments in his work that on a rigorous ethical environment people have to know what are the requirements to be taken when the survey is answered. In this paper students will be asked to answer the questionnaire in an honest way.

Another supporting element that was included at the design of the Likert procedure was the pre-context aid that were applied to student. The decision of pushing the first inquiry part in this direction obeyed to the origin of Digital natives –there has been presume that digital natives have the capability of working in a multitask environment (Kirschner & Karpinski, 2010). Hoping that this Likert aid could help participants to focus on one element at the time and have the opportunity of answering question in a fashionable proper contextually way.

The purpose of having concrete data will lead us to have a better interpretation of this phenomenon. That is, the better data is obtained about the investigation of their conceptions, the opportunity will be given for a better analysis, and therefore, the potentiality of a better interpretation.

Chapter 5: Findings

The results of this work will be presented in three sections for a better representation of the research questions' answers. The first section presents the demographics of the group. Second, discussions of the characteristics and practices of students towards the Facebook platform are presented. And finally, it concludes with the discussion about Facebook and its interaction as a virtual platform in the teaching of physics.

5.1Academic and demographic data

As explained before, the research was carried out in two groups of 25 students each. The first group consists of 78% female students and 22% male students. The second group consists of 82% female students and 18% male students. As we can see, the majority of participants are female.

Regarding age, the two groups of students were attending their first year of school and are representative of the digital-native digital generation. In both groups the percentage of ages was: 76% of students of 18 years and 24% of students of 19 years. As we mentioned previously (Galindo, 2009), the participation of the new generation of students called digital natives has reached the school. So, we have the task of modifying their learning environment for better use.

With regard to academic guidance, 98% of the students replied that they had not decided on their academic orientation and that they would continue to take only general education classes. Only 2% stated with certainty that their academic orientation is medicine.

Regarding their grades, 100% of the two groups answered that their Grade Point Average (GPA) was greater than 3.5. This result seems logical due to his short career in the school and the few units attended as a freshman.

Regarding the time students are connected online. The students of the two groups combined, told us that 16% spend more than an hour studying after school. Twenty-six percent said they spend more than two hours and lastly most, 58% spend more than three hours studying outside of school.

5.2 Academic use of Facebook Students' Conceptions

There are different discrepancies in the use of Facebook and the internet, for example (Karpinski& Duberstein, 2009) tells us that on some occasions Facebook users lose the notion about the social network and uses the internet to contemplate some of the objectives of the network, as if there were no division between these two. As we know, the social network of Facebook exists thanks to the internet, which is the medium that the social network uses to communicate.

For this study, a questionnaire was made to the students in which they were asked in a general way the use that they gave to the Facebook before the experiment in the classroom. The purpose of this questionnaire is to catalog the conception of Facebook as a learning tool in an instrumental way. That is, to define it as an artifact or as an instrument when interacting with this platform in an act of learning.

In order to have a clearer conception about the students' idea of the academic use of Facebook, it was important for this experiment to emphasize only the use of this social network, focusing on its use as a virtual learning tool, differentiating it from the use of the internet, so that, students did not mix conceptions. For this reason, the questionnaire presented to the students was divided into two parts, the first about the use of the internet and the second part dedicated to the use of Facebook. These questionnaires were used so that the student did not confuse the actions of Internet and those of Facebook, so that he could identify the function that gives each tool.

As we understand, the extraction of conceptions about representations of the use of Facebook as a virtual tool is a very delicate work. For this, in this experiment, we tried to investigate how the student relates the exclusive and habitual use of social networks with his academic work. That is, academic work in social networks is a reflection on the interaction that students have to enhance the use of Facebook as a learning tool (Escobar Marín & Rendón Londoño, 2015). The following are representative questionnaires of students' conceptions about the use of Facebook as a virtual tool for the education of physics.

5.2.1 Tables

Table 1 shows the students' conceptions about the use of the internet and their relationship with the academic part, obtained from the first questionnaire. As we can see 50% of the students are validating that the use of the internet has not in any way harmed the academic environment. In this survey, we have (STD = 7.47) and a (Median = 7.2).

The Internet and Academics.

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Internet distracts me from studying/doing schoolwork.	50	15	15	1	7	12
I use the Internet to procrastinate when I should be studying/doing schoolwork.	50	21	2	6	15	6
The time I spend on the Internet takes away from studying/schoolwork time.	50	25	16	2	5	2
If the Internet did not exist, I would get a lot more studying and schoolwork done.	50	7	21	4	8	10
I have missed a class because I was on the Internet.	50	0	0	5	40	5
I would be getting better grades if I spent less time on the Internet.	50	15	10	10	3	12
My grades are suffering because of my Internet use.	50	20	5	7	17	1

I am able to control my use of the Internet so that it does not interfere with studying/doing schoolwork.	50	4	17	3	20	6
When I am doing research for a course, I primarily use the Internet as a source of information	50	19	5	11	9	6
Overall the Internet has had a positive impact on my academic performance.	50	20	4	1	3	22

Table 1. Internet and Academics

Table 2 shows the results, also based on the Likert scale, used to investigate students' conceptions of Facebook usage. In this table, we can see how the social network of Facebook has a great relationship in the academic life of students, and there is no problem in the use of it. We can also see the great acceptance of the use of Facebook as a virtual learning tool, there is even a great acceptance for the use of Facebook in the field of teaching physics. This survey gave one (STD = 4.39) coupled with a (Median = 10.67).

Facebook and Academics

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Facebook distracts me from studying/doing schoolwork.	50	5	12	14	6	13
I use Facebook to procrastinate when I should be studying/doing schoolwork.	50	7	13	9	10	11
The time I spend on Facebook takes away from studying/schoolwork time.	50	4	11	15	15	5
If Facebook did not exist, I would get a lot more studying and schoolwork done.	50	14	8	5	14	9

I have missed a class because I was on Facebook.	50	12	2	14	7	15
I would be getting better grades if I spent less time on Facebook.	49	18	12	4	2	13
My grades are suffering because of my Facebook use.	50	12	3	12	13	10
I am able to control my use of Facebook so that it does not interfere with studying/doing schoolwork.	50	8	13	6	12	11
I have had to wait for a computer at the TECH Center or library because other students were on Facebook.	50	11	23	1	9	6
I use Facebook to communicate with classmates about course related issues.	50	16	8	10	2	14

Table 2. Facebook and Academics

Table number 3 represents the use of Facebook in a particular way. In this table, we try to recreate possible scenarios in which students could be affected in their personal existence by the simple fact of using the Facebook platform. In this questionnaire, we can see a neutral tendency. That is, students have found the appropriate medium for the platform to be a part of their life and not vice versa. In this survey, we have one (STD = 4.39) and one median (10.66).

Facebook Use.

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Facebook has become part of my daily routine.	50	8	14	11	8	9
I log on to Facebook and check it regularly whenever I am on the computer.	50	2	6	12	1	29

I lose track of time when I am on Facebook.	50	11	8	17	8	6
I have tried to cut down on my Facebook use.	50	16	2	6	15	11
I would be upset if I were no longer able to use Facebook.	50	7	13	5	14	11
Sometimes I go on Facebook while I am in class.	50	15	15	13	1	6
When I am not on Facebook I find myself wondering what I am missing.	50	18	10	1	12	9
I think I might be addicted to Facebook.	50	13	13	8	16	0

Table 3. Facebook Use.

In table 4, another aspect that this experiment intended to extract the contribution of the internet to the student's life. Thus, the use of the internet could affect the student's daily record. Let's take into account that there is a double interaction between the use of Facebook platform, the association of virtuality by Facebook and the association granted by the internet as a means of coexistence. As we see, students were inclined to answer the questionnaire in a conservative way in which no inclination towards a favorite side is shown. (STD = 8.34) and Median (7.2).

Internet use.

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I lose track of time when I am on the Internet.	50	12	15	3	6	14
I have tried to cut down on my Internet use.	50	21	2	6	15	6

I would be upset if I were no longer able to use the Internet.	50	25	16	2	5	2
Sometimes I go on the Internet for personal reasons while I am in class.	50	7	21	4	8	10
I think I might be addicted to the Internet.	50	0	0	5	40	5

Table 4. Internet use

Inquiring about conceptions is a very delicate work (Kember, 1997). Previous authors working with this kind of investigation have been expressed their concerns about the approaches of questions to turn them into factual answers. They always have been experiencing issues in the design of scales. In some inquiring developments, Likerting doesn't reflect the reality that the researcher want to seek. For this experiment our approach were supplemented with a preamble resource in which students were expose to a general inquiring process between the internet and Facebook as a general use. Continuing, in table 5 shown the inquiry about the Facebook's conception to support an academic achievements intrinsic dimension by itself. The panorama of the answers by students were giving with a really inclination to be a positive tool for the learning of the Photovoltaic theory. As we see, most of the questions are very favorable inclination to be Likertly "Strongly Agree" with the exception on one, the one that is asking about the future of the platform to follow being using as the major internet platform for academic purposes. For this question, they decline to be the next big thing. The (STD= 8.9) and the (Mean=8.5).

Table enquiry about conceptions

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you believe that Facebook offers a virtual environment for the learning of the photovoltaic theory?	50	32	5	8	5	0
Do you believe that Facebook is able to go beyond over its purpose and help you to enhance your academic performance?	50	19	2	6	15	0
I agree that the academic side of Facebook is a strong tool that all academic institution must use for academic purposes?	50	22	16	2	5	0
Do you believe that Facebook have a stronger relationship with your academic performance?	50	16	21	4	8	0
Do you recommend the use of Facebook for academic purposes?	50	12	0	5	40	0
Do you believe that Facebook is the best platform for learning online?	50	32	10	10	3	0
Do you believe that Facebook has the proper tool to support the leaning of Physics in a virtual environment?	50	19	5	7	17	0
Do you believe that academic learning over the Facebook platform is not very difficult?	50	18	17	3	20	0
The use of Facebook academically can help you to upraise your grades?	50	6	5	11	9	0
Is Facebook the next big thing on academics?	50	20	4	1	4	16

Table 5. Table enquiry about conceptions

Table 6 shows the time spent by students to study and perform their school work. The table is organized in time, and the percentage of students participating in the test fall into that category. On average, it takes 1.7 hours to perform these activities, with a standard deviation of 1.37 hours.

Percentages of Time spent on studying and doing schoolwork

		Time spent per day						
Activity	n	30 min	1 hr.	2 hr.	3 hr.	4 hr.	5 hr.	6 hr.
Schoolwork	50	28.4	32.6	12	16.2	6.4	1.5	2.9

Table 6. Percentages of Time spent on studying and doing schoolwork

Students were asked about the technological device they mainly use when they want to access the internet. The concentration of the answers is shown in Table 7, where the percentage of participating students that chose each of the devices and combinations of them can be observed. As noted, the highest percentage is the use of Laptop, followed by the combination of Laptop and Desktop.

Technological Devices Used to Access the Internet

technological device(s)	n	%

Laptop	19	38%
Laptop and Handheld	5	10%
Desktop, Laptop, and Handheld	5	10%
Desktop and Laptop	15	30%
Desktop	3	6%
Desktop and Handheld	3	6%

Table 7. Technological Devices Used to Access the Internet

Table 8 shows the frequency with which students access the Internet and Facebook. It has an average of 4.48 times a day (with a standard deviation of 1.17) for the Internet case and 4.11 times a day in the case of Facebook (with a deviation of 1.6).

Percentage of internet and Facebook Uses Frequencies

	Internet (n=50)	Facebook (n=50)
Frecuency	%	%
Once a week	0	0.5
Once a day	1.2	3.6
2 times per day	3	12.5

3 times per day	18.5	25
4 times per day	19.5	18.3
5 times per day	35.5	14.5
6 times per day	19.8	19.2
Other (please specify)	2.5	6.4

Table 8. Percentage of internet and Facebook Uses Frequencies

Table 9 shows the results of the survey of participating students on the time used on the internet and Facebook, separating it in academic use and recreation use. Participants reported that the Internet uses it on average 4 hours a day (with a standard deviation of 1.82), for academic activities, and 4.39 hours a day (with a standard deviation of 1.94) in recreational activities. In the case of Facebook, this is used an average of 4.23 hours per day (with a standard deviation of 1.87) in academic activities, and 3.03 hours per day (with a standard deviation of 1.67) in recreational activities.

Percentage of time spent on the internet and Facebook

	Academic		Recreational	
	Internert use (n=50)	Facebook use (n=50)	Intenet use (n=50)	Facebook use (n=50)

Frequency	%	%	%	%
30 minutes or less	2.5	3	2	5
1 hr.	4	5	5	19
2 hrs.	15.5	16	14	15
3 hrs.	25	12.5	15	25.5
4 hrs.	14	14	12.5	12.5
5 hrs.	12.5	15.5	15	12.5
6 hrs.	14.5	24.5	20	10.5
More than 6 hrs.	12	9.5	16.5	0

Table 9. Percentage of time spent on the internet and Facebook

Table 10 shows the waiting time between one visit to the Facebook portal and another. On average, participating students expect on average 49.45 minutes (with a standard deviation of 45), to re-access to Facebook.

Percentage of delay of Facebook Use

Frequency	n	5 Mins	15 Mins	30 Mins	45 Mins	1 Hr.	2 Hrs.	3 or more Hrs.

Delay	50	12.5	15.5	21	26	8.5	10.5	6

Table 10. Percentage of delay of Facebook Use

In Table 11, titled the Three Most Common Facebook Activities, participating students were asked about the most common activities they perform when using Facebook. They first responded openly and then their answers were categorized into the categories shown in Table 11, categories based on the standard features of Facebook itself.

Percentages of Three Most Common Facebook Activities

Facebook activity	Activity one %	Activity two %	Activity three %
Talk to friends via chat, private messages, wall posts	10.5	16.30	17.66
Read news feed	30.5	16.30	0.52
Check notifications	12	16.30	4.42
Look at photos	18	16.30	0.26
Look at friends' pages/profiles	5	16.30	15.06
Check/update page/profile	1	16.30	18.18
Check friends' statuses	2.5	16.30	11.69
Update status	4	16.30	8.57
Comment on friends' photos, statuses, posts, comments	9	16.30	18.18
Use applications (play games, listen to music, shop marketplace)	7.5	16.30	5.45

Table 11. Percentages of Three Most Common Facebook Activities

The conceptions of students after having had experience with using Facebook in an academic manner were positive. Some authors mention that the changes of opinion about the potentiality of Facebook change after having had some experience in the use of it. For example in his work (Bosch, 2009) tells us that the change of perception about Facebook takes a positive direction after the conclusion of the experiment. The author mentions that positive benefits increase with the use of Facebook academically. Results from the perspective of using Facebook academically focused on teaching physics are reflected in most of the tables. It is noted that about 85% of the students surveyed commented on their experience was positive. Another answer about the Facebook tools necessary for the teaching of physics through virtual means shows that 78% of the students answered positively and the rest of them were maintained in a neutral way. One of the most controversial results found in this questionnaire is the acceptance of students that the use of Facebook for academic purposes helps, to a certain extent, to have a better degree in the subject, where 60% of the respondents answered in a neutral way and 12% of them answered in a negative way. At best their conception of having a good academic degree is not the result of the use of tools but of the commitment that is put to the class. In one of the last questions reflecting the students' conceptions of Facebook use if it offers an educational environment strong enough to support a physics class, 98% Students had a positive concept, only 2% Maintained in a neutral manner. In one of the last questions reflecting the students' conception of Facebook use if it offers an educational environment strong enough to support a physics class, 98% Students had a positive concept, only 2% Maintained in a neutral manner.

As we mentioned earlier, surveying is a powerful tool able to describe any scenario even if this one is a very complex one. The base of this clarification is base in the conception of the proper

tool chosen for the action. In this case, the questionnaire was a really basic but powerful tool able to give an approximation about the perceptive ideas about the use of Facebook as academic tool on students. Result, with any doubt, certainly seems as positive result which will be discussed in the next chapter of this report.

5.3.1 Instrumental elements (Question 2)

As we have reiterated, the theory of instrumental Genesis is very useful for the discovery of instrumental schemes that can be used directly when using technology. One of the great challenges at the time of working with this theory was the observation of the instrumental schemes developed by students when exposed to the use of technology, which is a very complicated task. Possibly, the best way to recognize them is when they use skills later on, that is, they are used and recognized at the time of execution. For this work we tried to investigate the practice of students towards the use of Facebook in order to have a better idea at the time of the creation of the virtual classroom. It was taken into consideration that we were dealing with native digital students and in addition to this, most of them had commented that they had a great experience using the social network. The results of this questionnaire agree with the previously mentioned and show that one should experiment with the virtual classroom in a certain way that will generate new instrumental elements at the moment of interacting in it.

As discussed, the investigation of instrumental schemes is not an easy task. That is why with these two upcoming surveys, we tried to inquire about the degree of familiarity that the student has towards the use of Facebook. As in previous surveys, two parts were also considered for familiarization, one for the Internet (results in Table 4) and another for Facebook (results in Table 3), with the purpose of emphasizing the division between the virtual network and the internet. We can see that the questions in this questionnaire correspond to the same order which

creates the student an imaginary line to understand the coexistence and visualize the environment where they are.

As we mentioned earlier the extraction of instrumental elements from the order of instrumental genesis are subjective in nature. There are several studies in which different authors agree on the difficulties of observing instrument schemes. For example (Reyes Castaño, 2014) tells us in his research paper that the schematics instrument would seem of a compressive order. That is, it would be necessary to implement the activities in a particular way for their extraction. We can also add the research of (Reyes Castaño, 2014) which tells us that the approach to enter into the implementation of a theoretical framework such as that offered by the instrumental genesis is an unexpected complexity.

For this research, it was proposed to face the challenge of observing instrumental schemes through two types of dynamics. The first was regarding observations made at the time of the implementation of the virtual platform Facebook in an academic way. The second one refers to a questionnaire supplied to the students who participated in an experiment in which it is tried to inquire about the active instrument schemes of the order of the instrumental genesis experienced by the students.

5.3.2 Instrumental elements by students (Question 2)

For this part of the research, students were asked three questions which had to be answered at the end of their last questionnaire. These questions were intended to clarify what instrumental elements students might have developed when using Facebook as a virtual education platform. These three questions were free response of which we had different answers with very varied positions. The result of these responses was very complex of the theoretical framework in

which the students were exposed. Recall that students had no idea about the theoretical framework in which they worked - the instrumental. They simply lent themselves to answering the question as much accurate as possible. For this, they were introduced superficially to the Instrumental Genesis. This gave them a better understanding and could have a better answer. Moreover, for a better answer, I want to make clear, a contextual response and not simply a sharp yes or no answer to the questions that have been asked.

Below are the questions that the students had to answer at the end of the questionnaire.

1- What were the practical elements that contributed the use of Facebook as a virtual educational tool that will help to have a positive experience when learning your physics class?
2- You consider that the use of the virtual platform of Facebook oriented to the education is completely alien to the use of Facebook like social platform. Why, explains the differences, that you learned is the handling of Facebook different from regular Facebook.
3- What elements or environments you had to learn to use Facebook in an academic way that was outside the use of Facebook in a social way.

As we can see, in question number 1, the questionnaire concentrated on inquiring about the elements that were developed for the use of Facebook in an academic way. For this, we understand that most of the students were familiar (existing instrumentalisation) with the use of Facebook as a social tool and not as an educational tool, so there were some elements that were developed in an academic way.

On the other hand, question number two proposes students who will answer about the technical differences or tools used in the use of Facebook when using it as an academic tool. In this

question, the students were not very positive about the differences that existed when using the Facebook platform in another aspect to which it was not designed.

Finally, in question three, students were proposed to show situations in which they have generated new schemes to be used on the Facebook platform. These new instrumental schemes would have to be of a different order than the ones they usually used when using Facebook in a social way.

Below we present a series of answers of some students regarding these two questions formulated in the questionnaire:

"I did not find any difference between using Facebook in any way."

"The only difference were the new commands that we use the instructor teacher is discussed in order to have a better class."

"The commands that the teacher put to help us with the class I think was the only difference ... I had to adapt to them."

"If there was much difference between using Facebook to socialize and to educate ... It is very difficult to concentrate."

"The wall that Facebook used is very different academic use than social use ... I had to adapt to read and understand on a small screen of the phone."

5.3.3 Observed instrumental elements (Question 2)

As we had contemplated, instrumental elements generated by the process of instrumental genesis are a very difficult process to observe. To begin with the subjective contemplation of these, we follow some suggestions extracted from (Montiel & Del Castillo, 2009) which tells us that the instrumental genesis is the course of a complex process that needs time to relate to

the characteristics of the artefact with activities of the Subject and their previous knowledge and their old method of work.

Before beginning with the narration of the instrumental processes observed in the students, it is commented that for this work observations of two indoles were made. Process of instrumentalisation and the instrumentation process.

According with (Montiel & Del Castillo, 2009) that instrumentalisation is the course of the instrumentalisation process in which the subject appropriates the initial properties of the artefact, derived from its first use. Thus, the subject fits the artifact. In this part of the process of instrumental genesis called instrumentalisation, there is also possibility that the subject can build new functions of the artifact. All this depends on the user's need. In our instrumental process given in the experiment there were two very important observations of this first stage. The first generalized observation of most students was the appropriation of the artifact. The virtual platform of Facebook cataloged in its first stage of the process of instrumentalisation. in other words, students observed like an artifact. It would seem that none of the students had any problem to the adaptation of the artefact. Most of the students had already some formal or informal approach to using the Facebook platform. Although the students' experience in using the Facebook platform was of a different nature - social network did not register any act that could call for attention and reflex that the artifact was foreign to students. In this observation, it was also contemplated whether there was the need for the student to adapt to some need for the use of the artifact. In other words, no student had any problems or required training through the class to start using the platform in a different way.

Continuing with this approach, we say that this process involves different steps. The first step consists of the discovery and selection of elements necessary for the operation of the virtual

platform. This stage was definitely one of the simplest. Students had no problem finding the use of all the tools provided by the Facebook platform. Again, this was derived from previous experience that students had to use Facebook in a social way. We only found some of them that distracted by some new implementation of tools was not of their recognition. These students, seeing these tools, had no problem assimilating them. At the time when students faced a new tool to be used on Facebook as a academic enhancement, students knew what to do, and they used it without any problem.

Another step corresponding to this part of the instrumental genesis was the step of personalization. Let us understand this step as the step of transformation of the tool. In it, the subject makes the pertinent modifications that were not contemplated by the designer of facebook's page. For example, the optimal arrangement of your personal Facebook page to be able to have a better understanding of it. For example, some students had opportunities to make moves to their internal page structure. sometimes, they moved modules from the Facebook page in a relevant way to have a better understanding or at least to be more effective. Also, many of the students, created some personal tools that will help them to have a better experience when using the Facebook tool. The students went directly to the Facebook platform and started experimenting with it without any problem. They had a clue where all the tools they needed to attend the class were located. Students definitely had a well-constructed idea about Facebook as an artifact and also way beyond how it should be used. All these. They are not a good support for the elaboration of the instrument so we understand that the elaboration of the instrument occurs in its use. The instrumentalisation leads to the enrichment of an artifact (Trouche, 2004). In this case from these generalities, we began our process of instrumentalisation in a favorable way. The students had the notion of the artifact and even further in the use of that artifact, and the use of it for other assignments other than the act Facebook was designed.

Following the observations made to students when using the Facebook platform as a learning tool and following the direction presented by (Montiel & Del Castillo, 2009) in their work previously proposed, we continue with the process of investigating about the process of the instrumentation. The instrumentation refers to the construction of schemes of work, so that, the subject in question can use the artifact in a more constructive way. In other words, the development of use schemes that are subject themselves. According to our conceptual framework there are two components in the creation of use schemes. The first is a private component. These components belong to the subject and are developed under their experience. With regard to observations made to students' private components at the time of the use of power for almost nil. Most students reported negative results on this part of the Instrumental Genesis. Probably, students who reported some of them did not understand the question at all. Even further, in the instrumentation process, there is a social component, as a result of the interactions of the subject to the moment of socializing with the other students, besides this can be reinforced with different aids of external elements. For this part of the social components we can say that it was null. No questions or even any observations from students when using the Facebook platform academically. Only one case of a student who referred about the operation of the device in which it was. This means, your question was asked to reform a problem about the hardware used for navigating the Facebook platform.

As we know, the instrumental genesis allows to evolve the conceptions that the students have about the use of the instrumental object. For example, the conceptions are developed in a certain way that adapt to cover the needs or difficulties that a tool can bring with it and in this way, to potentiate the use of the artifact in its day to become an instrument. In the case of this experiment the conception about the use of Facebook was very positive. I could say that most of the students did not have any problems to use the platform socially and when they faced

accommodation of the Facebook page corresponding to the physics class, it was entirely new to them. It took them no time to familiarize themselves and find a way to make the Facebook platform not an impediment to how to learn. So, you could ensure that there was no evolution and not even some consideration about the new use of Facebook.

Another important part of the instrumental dynamics of the instrumental genesis is the pre-adaptation of the intrumentation schemes with the new schemes at the moment of being discovered in the occult properties of the artifacts. This requires active elements of the instrumental order that the artifacts comprise in a certain way and are hidden from the subject. There must be some experience to be able to adapt the new schemes as well as their significance of the artefact and the association with the new schemes. In this case, the students answered in their open questions of the final questionnaire that found no new way to handle the Facebook platform. They continued using Facebook in a natural way as if they were using the platform for social use. Up to this point, we understand the second dimension of instrumental genesis as the generation of new schemes of use and their adaptation to coexist with existing ones and give a new approach artifact in such a way that it loses its unique feature and to adapt to the context in which the subject begins safe from a different one. This is artifacting upon the instrument. Again, analyzing the points thrown by the surveyed students, we can see that most of them did not even comment that they have acquired the certain type of experience that has helped them to use the Facebook platform in a way we could say more advanced and academically but also to the use of Facebook as a social tool. In this case, we can say that schemes of use of the order of the instrumental were almost null in such a way that they were not even perceived by the students. For this experiment, the expectations find schemes of use to comply with the use of Facebook as a virtual platform such was too high. On the contrary, the orientations that in a certain way were believed of a new order proved to be existing.

For this experiment the technology of Facebook was proposed in a frame of reference of the instrumental genesis in which the schemes of use would be looked for to indicate how the technology integrates to the student so that the knowledge of the concept of the photovoltaic theory outside construct in such a way that the student significant educational experience.

We understand that the programming of the learning environment provided by the social network of Facebook, the proper discernment of the schemes of use would help us to develop the instrument to a degree that allows the student to take ownership of it as an integral part of it and to have the opportunity to build knowledge of the photovoltaic theory. In this way, our experiment would conclude with the elements necessary to indicate which schemes of use would turn our artifact, Facebook, into an instrument.

As we mentioned earlier, the work of inquiring about conceptions of students and also the construction of observations of schemes of use in the order of instrumental genesis is a new work, but certainly was a very large contribution in the following section will be an analysis of the results obtained in these surveys.

5.3 The learning experience within Facebook (Question 3)

Studies indicate that the conception about distance education of students at university level changes after having had an educational experience in a virtual setting. For example, (Navarro, 2004) comments on his research on measures to exploit the conceptualization of the efficiency of distance education as well as students subject to educational models in virtual mode change of opinion. In our case, the group of contemporary native digital students, we suggest that their digital experience is not something new for them. Remember that they are familiar with the

virtual environments of their environment. On the other hand we can also see that certain research papers tell us that in digital natives have different profiles and virtual conceptions of the academic aspect so we can say that they are almost null (De la Torre, 2009). In spite of this information, in this research experiment, the results about the satisfaction of the use of Facebook as a learning tool probably does not reflect the letter of the investigations of the studies made previously. On the contrary, we can see a great variety of positions on the conceptualization of Facebook as a virtual education tool.

So, we can understand this as a development of tools limited to the use of educational elements that could be embedded in the Facebook page. We must remember that Facebook's virtual platform can be designed for different purposes. We also understand that this work consists of verifying if the platform offers the right tools to have a positive experience in the learning of Physics. But in the end, we recognize that its primary goal of Facebook is social virtualization -socializing virtually.

More information about these observed discrepancies will be given in the next chapter. The use of Facebook as a virtual learning platform although it maintained a good level of acceptance by the students, we also encountered certain difficulties that had to be faced. These same were conceived the instant in which the experiment was carried out.

The following is the questionnaire in which the students' conception and satisfaction about the use of an academic way is investigated.

Table 13 gives us an approximation about the perception after using Facebook as a tool. As we can see, the positive response from the students was eminent. Also we can see, only 2% of the

students answered in a totally negative way. But in contrast the positive use of Facebook as a virtual education tool took a positive turn with 53% of the questions in the questionnaire. Only 20% of them held power plants. We can assume this result (STD = 26.66) and one (Median = 6.88).

Post-conceptions about the use of Facebook academically

Survey questions.	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you have a positive experience during the learning of the PV Theory under Facebook environment?	50	42	6	1	0	0
Facebook offers all necessary to support a learning experience.	50	39	2	6	3	0
Facebook should be using more often for academic purposes.	50	25	2	18	5	0
Facebook is able to support a learning environment for teaching physics.	50	47	3	0	0	0
I will recommend the use of Facebook for academic purposes to others professors.	50	40	10	0	0	0
The use of Facebook as academic tool is for the exclusive use of the learning of Physics.	50	0	0	10	39	1
My grades are better because I use Facebook for the learning of the PV theory.	50	2	12	30	0	6
The best way to learn Physic is with the aid of Facebook.	50	4	19	23	0	4
Facebook offers a useful and meaningful educational environment able to support,	50	41	8	1	0	0

enhance or strengthen the learning of Physics

Table 12 Post-concepciones acerca del uso de Facebook

As we commented at the beginning of this experiment, to inquire about the conceptions and experiences of a virtual activity is a complex work. But undoubtedly, these tables give us a positive panorama about the satisfaction of students in the use of Facebook as a virtual learning tool.

Chapter 6: Analysis

One of the purpose of this study was to discover the concept of the social network Facebook to be used as a learning environment which helps to study photovoltaic theory at university level. Another purpose of this work was to discover instrumental elements that indicate that the use of the social network Facebook facilitates the development of schemes of use which add value of using Facebook platform thus cram the learning of photovoltaic theory in contemporary students. Finally, we explored the satisfaction of students about the learning experience induced by the social network of Facebook used as a virtual platform in the learning of physics.

The relevance of this study is primarily based on the study of elements provided by the theory of Instrumental Genesis, which had never been used - until the time of writing this report and in my knowledge - in a practical way to demonstrate the potentialities of the virtual social network educationally.

6.1 Answers to research questions

Below are the research questions with their respective results of this research project.

***Question 1*: Artifact or instrument? What is the student's concept regards Facebook as virtual learning environment to cram the photovoltaic theory?**

The first research question specifically explores the students' opinion about the academic potential of the social network Facebook. For this a questionnaire was developed on the habits in the use of Facebook in his daily life and another one of academic way - the use of Facebook in the school. Questions such as: How much time do you spend on the internet and Facebook? How much time do you spend on task development? What activities do you do on Facebook? Just to mention a few. To see the complete list of questions, see the appendix.

The perceptive act of discovering conceptual facts is a delicate work. The need of an applicable methodology is a must for the researcher in order to collet quality valuable data. The collection of these conceptions had two dimensions' approaches, intentionally developed, with the purpose of obtaining valuable data from student's conceptions. The first approach functioned as the preamble to characterize the dimension in which Facebook must be understood to be interpreted. The second approach had the purpose of extracting conceptual facts derivate from student's perceptions about Facebook educationally use. The objective, the academic potential derivate from Facebook to be use academically. According with the out from students, Facebook offers the necessary elements to support le learning of the Photovoltaic Theory in a virtual mode.

***Question 2*: Under the perspective of the "Instrumental Genesis", how the use of Facebook as a learning environment facilitates the learning of the photovoltaic theory in contemporary college?**

For the quest of elements of the instrumental order, a survey and observations were carried out on the instrumental elements on what Facebook counts as a learning platform. In this part of the research, we inquire about the instrumental elements conceived by the use of Facebook, using the theory of Instrumental Genesis, which is a relatively new theory that has been exploited for the search for instrumental elements that arise through a process in which an instrument ceases to be a tool by itself to become an element of utility for the person. In this case, it is a question of investigating the instrumental process that the students experienced when working in the Physics class and using the social network of Facebook as a learning platform.

The survey was elaborated using the 5 points of the Likert scale, which indicates five levels of appreciation about the questions elaborated which are:

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

The results of the application of the survey to the 50 participating students are shown in the following table:

Inquiry questions about instrumentation	**1**	**2**	**3**	**4**	**5**

How do you consider your experience in using Facebook as a technological learning tool?		7	10	15	18
Do you needed new elements to manage the Facebook platform when using it as a technological learning tool and not as a social network?	1	6	19	26	4
Was your experience of using Facebook as a virtual platform in an academic way very good?				8	42
Are the tools offered by the Facebook platform optimal to be able to use it as an academic platform?				46	4
Does the Facebook platform need more elements that are specifically developed for academic tasks?	5	40	5		
Did this learning task helped you develop certain skills in the use of Facebook that will be useful in the use of this platform in a more orderly and different purpose from which it was created?	46	4			
Won't you use the Facebook platform for any other use other than for the social network	50				
Were there any different skills you had to develop to use the Facebook platform as a learning source? Please comment on what they were. (Open)					
Please, explain the difference between the skills required to use the Facebook platform as a learning tool and as a social communication tool. (Open)					

Table 13

To answer the second research question about how Facebook facilitates the learning of photovoltaic theory from the perspective of instrumental Genesis, several categories were explored to discover unique instrumental elements of Instrumental Genesis, which would help the student to approach in a way more solid the use of Facebook platform as a technological learning tool. As shown in the answer to the previous question, the survey made to the students

for the investigation of the instrumental elements provoked by the use of Facebook gave us the following data:

The instrumental schemes generated by the use of Facebook were minimal. 75% of the students surveyed responded negatively in the generation of new schemes, movements or alterations recognizing that they were generated exclusively for the use of Facebook as a platform when it was used as an educational platform. This meant, the majority of students did not require any new skills to be used on Facebook when interacting academically on the virtual platform. All the skills needed to manage the virtual network had previously been added under the use of Facebook as a social network for personal use.

Regarding previous experiences that students expressed in the use of Facebook as a virtual platform for academic purposes, 100% of the students reported that they had at least a past experience in using Facebook as a learning platform. 82% of the students surveyed reported that the use of the platform as a learning tool was not entirely pleasant, against 8% who reported that it was of total pleasure.

Regarding the evolution of new instrumentation schemes organized in a certain way to be developed in the practice of Facebook as a learning tool, the students answered in a very different way.

Along with this research question, a few more open questions were asked. These questions were designed to have a better idea about the evolution of instrumentation schemes that are required in the use of Facebook as a virtual learning platform. The first question was:

Did you develop different skills that you had to use on the Facebook platform as a learning technology? Please comment which.

The second open question was as follows:

Please explain the difference between the skills required when using the Facebook platform as a learning tool against as a social communication tool.

For the first question, 10% of the students proposed different skills necessary for the use of Facebook as a technological learning tool. Ninety percent of students reported that, if Facebook's social network is used to socialize virtually, these same tools can be used in the network for more specific uses.

In the case of the new skills reported by the students needed to use more properly the social network of Facebook as a learning platform, only some of them, (2%), reported that familiarizing themselves with some of the tools offered by Facebook, which are usually not used when the platform is socially used, is based on a single conception. At the time of using these specific tools, they had no problem. Although the Facebook platform has different tools, the use of these are not exclusive to the social part. Although, they are not very common when using them in the default setup of the page, we see that they share a design in common - particularities are very similar. So, the students adapted them instrumentally. They copied some scheme of use from another Facebook use and adapted it immediately for a uniform implementation.

Another skill reported by students that needed to be developed was the addition of new built-in tools added to Facebook. Facebook platform is constantly changing, Facebook designers generate certain tools to make the experience more pleasant, but unfortunately in some occasions only run into them -built-in tools. The students were not completely familiar with the use of them, as the Facebook page does not adequately inform about the tools offered by

the platform and how to use them. In this part of the experiment, in my opinion, it was the most descriptive instrumental part that manifested itself. Here, we can visualize how the students had the opportunity to face the use of a new tool and also take the opportunity to use their previously conceived instrumental network to adapt the required scheme to cope with the act of learning aided by Facebook. As an example, we have the following comments from participating students:

"I had to familiarize myself with other tools that I was not familiar working with before. But not difficult at all."

"I had to learn how to make a division between the social part and the academic part."

"I had to learn how to manipulate the platform in such a way that I could get in and out of it in order to work with my general tasks, at the end, I had to learn how to use all the tools offered by the platform."

With regard to the investigation of instrumental elements, we commented that the answers were of a varied nature. That is, some students were not sure of having the skills necessary to use Facebook as a learning platform but tat the end any punctual observation were claim. We did not experience any kind of scheme of use that help us to claim that this scheme of use is new and will be integrated in such a way to support student's learning experience in a better way. They commented that they had experience using the platform, but only superficially and to socialize. 60% of the students surveyed were sure to have sufficient capacity to handle the Facebook platform for different purposes. 28% of the students were neutral about the Facebook domain. In previous studies such as those presented to us (González-Ramírez et al., 2014)

comments that the measurement of skills in the use of Facebook has increased with the beginning of digital natives in the university.

Regarding the skills needed to manage the Facebook platform as an academic platform, 100% of the students replied that there was no difference between the uses of the Facebook platform in the social aspect versus the use of the platform academically. This makes reference to us that the students were not exposed to any instrumentation actions or at least, it was not notable for them. No instrumentation scheme was generated to be used academically on the Facebook platform.

In order to investigate the tools available for the Facebook platform, students positively commented that the tools offered in the platform are sufficient to support an academic environment. As we know, the social network of Facebook is a combination of different tools which can be used for different principles. For example, we give you a wall that is the beginning of a blog. In this, a series of messages are accessed from the contacts. In the wall you can add videos, images and notifications. It is important to emphasize that for this study only the basic tools of Facebook use were used. As we know, Facebook offers a variety of tools that can be added to the platform; some of them, come from tool developers and they have a cost.

Regarding the search for new important elements to make the Facebook platform more efficient in an academic way, 45% students reported that no element was necessary to add to be able to use the Facebook platform in an academic way. The rest of the students surveyed remained neutral in the sense that it was not necessary to create new tools and the development of new techniques to be integrated in the platform of their Facebook and to be used as a source of

learning -unknown tools certainly. With regard to the instrumental part, apparently, students do not want to deal with certain new elements that could be of benefit to them, but that would imply more work when developing more instrumental elements, in such a way that they can dominate the tool in order to be able to use it in a more effective way. The lack of knowledge of instrumentation schemes generates some rejection to the adaptation of the same or to the creation of the same.

Regarding the number of instrumentations schemes generated for the use of Facebook as an academic platform, it would seem that there were none. Student reported that there was no difference in the use of the platform, either socially or for academic purpose. The tools were the same and had to be used the way they did to communicate socially. 92% of the students reported that they did not identify any instrumentation scheme or at least some significant adaptation to use the platform in an academic way. Some students commented as follows:

"It's exactly the same, the tools you use in a virtual way to communicate in the social network you use to communicate with the teacher and colleagues."

“No problem at all.”

“I didn't have any problem using Facebook as communication tools as well as academic platform.”

“I think, it is exactly the same way as using for social events.”

I want to emphasize this part of the research because the elements thrown out by student surveys indicate that the lack of instrumental elements was a reality. That is, the responses thrown in this experiment indicate that contemporary students are immersed in technology and

that we could say that this technology is part of them. For example the work of Cabra-Torres & Marciales-Vivas (2009) comment the following:

“These new students are immersed in technology.”

The students of this experiment are in the line of the digital natives. This is the positive aspect of the survey.

In the last question, students were asked about their confidence in using on the Facebook platform as part of their academic training. 100% of the students surveyed positively and reiterated that they would use the platform again for this purpose. The confidence of this answer makes us see what about the instrumental part. In other words, in the management of the virtual platform, these contemporary students have no problem to use. Therefore, the platform of Facebook these days, for this type of students, lays as an active instrument category, in other words, the artifact became an instrument priory.

***Question 3*: What is the students’ satisfaction about their learning experience induced by the use of Facebook as virtual environment for learning Physics?**

It is essential to have a virtual educational experience in order to have a better understanding of virtual education (Sangrà, 2001). In this experiment, the graphs and tables show a positive perception of the use of Facebook as a virtual education tool from a students' point of view both before and after the application. Even those students who without previous experience in the use of Facebook as a virtual learning tool and social platform, gave it good comments on this social network for academic use. Some of the comments were:

“They had already taken time to do something like this.”

“I would like to have more classes in this virtual platform.”

“It is very different -cool- to use the Moodle administrative platform, to use Facebook as a virtual platform.”

“Facebook has everything it takes to have a distance class.”

“I would love to see that my teachers being more open mind and can using technological tools like this to have a better class.”

As we can see, the conceptions of the academic use of Facebook were positive. Some authors tell us that the use of technological tools change in a certain way the pedagogical vision of a class. For example (Cervera, 2004) in his work tells us that in some cases, if a virtual class is not properly conceived, students tend to have certain conceptual distortions, which border on having a very poor learning experience. In our case, the learning subject was the photovoltaic theory to reinforce the physics class. We can see that its acceptance was a total satisfaction of the students surveyed. For this, they used tools of the virtual platform of Facebook to support the physics class. It is important to emphasize that only one subject was approached by this means and not a whole class of physics, but the results are positive and suggest a continuation. Although some authors strongly disagree with the use of Facebook as an academic tool (Roblyer, McDaniel, Webb, Herman, & Witty, 2010) mentioned that it is difficult to have a quality learning experience in a virtual network that was not designed for this. Prior to this research, some colleagues from the institution, where the study was carried out, showed dislike, negative attitude and a certain taboo about the possibility of using Facebook as a learning tool. The attitude of these teachers changed a bit when this research began to delve some little more solutions about the problems of how to educate contemporary students. Moreover, the finding a new theoretical framework that helps to be closer to these students was something undesirable to understand. At the end of this research, I had the chance to talk againg with teachers who

had some doubts about the experiment. Even showing certain positive results, were not convinced; nor took a positive attitude in the use of Facebook as an academic tool.

To end, I try to involved some faculty no just to participate in the experiment but also to review some result. Apparently, no signs of interest observed by faculty members. Still, the topic is far away to be observed as a serious matter for teaching these new students or at least just be closer to students at the time of teaching.

6.2 Complications of the study

As we have previously mentioned before, the fact that we had not find a significant relation of conceived instrumentations was provoke by the limitations of the study. For example, the group of students who was chosen to carry out this experiment fall into the category of digital natives. To mention some citations of some previous work by authors focused on the study of digital natives findings, we have the example Amador(2010) where the author tells us that one of the characteristics of digital natives is a psychological training at the time of being exposed to technology. Therefore, the instrumentation coupled with the appropriation of Facebook as such tool, had been formed prior to the implementation of the study; Because all the participants had already been exposed before the social network, even for different purposes. To this one can be added the complexity of the capture of the moment of formation of schemes of use given in the instrumental stage pertinent to the instrumental genesis. Unfortunately, this is an emerging theory and is still in the process of developing a better interpretation of it. The exposure to technology, Facebook, by digital natives during their entire life was the line which carry out the findings of this experiments. Digital natives are instrumented in technology. This environment of technology make the student had developed required schemes of use need it for the use of Facebook as a learning tool.

Another situation that probably could be able to throw clearer results for this experiment -if there were any- is undoubtedly, the methods for capturing instrumental schemes. It was one of the great obstacles to the development of this experiment. Capturing schemes of use is a very complex situation. This action must be executing carefully. Unfortunately, there is not any clear methodology for the extraction of these type of elements but observation. Observing phenomena is an action that could be validated in certain way to no alter observed result. For example, different points of view and background could be enough to obtain discrepancies at the time of grabbing results. We hope that in the future, there will be more experimentation and development of methodologies that help us to have a better vision about the formation of these schemes of use.

Moreover, results could also be influenced because there was no balance between male and female participants. 69% of the students surveyed were female. Studies such as that of (Gómez, 2012) show that women are the main users of social networks. This trend is also reflected in the results of this research, where it was reported that women spent more time using Facebook compared to men. Having a high percentage of female participants who might have a great familiarity with the use of Facebook may be the reason why no significant instrumental features were found.

The results also show that female participants have more than twice as many distractions when using the platform as the male gender. In the doctoral work of O'Brien(2012) the participants of that study answered that "they lose the notion of the time when they are in front of the computer like user of Facebook". We could associate this lack of interruptions when using the Facebook social network with an apparent ability of the student to control the social network

in a high level instrumental way, which means that it is very easy for the student to be navigating on this platform.

Conversely, the results show that 67% of the students surveyed assign a negative effect derived from the use of Facebook as a source of academic distraction. The use of technology in the classroom tends to be a distractor when using technology in a classroom (Gehlen-Baum & Weinberger, 2012). For example, students answered that when they are in class they have opened the Facebook page to communicate for different subjects than the academic. Moreover, other students say that it is a great temptation to have a computer in front of them when they are participating in a class. An example of a student who commented:

"I always want to be watching what is happening with my Facebook page instead of paying attention to the class."

In the part of the questionnaire that asks about the time that they use in Facebook and in the internet, it is important to emphasize that the difference of use between the social network and the internet is very small. 97% of the surveyed students had doubts in answering this question because most of them had in mind that being on Facebook or being on the internet was a similar thing. In some cases, they did not identify the use of the activity. They did not know if they were on Facebook or were using the internet. The students simply knew that they were interacting in a virtual way.

Another constrain in the developing of this experiment was the association of grades with the use of Facebook. It was a big conception about the relationship between the use of Facebook and the grades. Even do, there exist many documentation about the relation between the use of Facebook and grades, the majority of documents I researched don't support this fact, For example (Pasek & Hargittai, 2009) mediated a research in which was not found any evidence of a relationship between Facebook use and grades. In another example (Stollak, Vandenberg,

Burklund, & Weiss, 2011) are commenting that the relationship between grades and Facebook are related to the time consuming in the social network but not related to the use of the internet with a slow rate. But students' misconceptions were unfortunately heavy constraints on the limitation of this study. Students limited themselves in the use of Facebook at the time of the experiment. Now, we surveyed first year college student. They have a very good current GPA at college. The reason of this, they have been taken small number of classes since they started college. One more thing, most of the student are taking their first year at college. They haven't been over situation where the need of the use of internet is a need for academic work. Probably, for many student, if was the first class which requires the use of the internet for academic purposes.

In the question about the relationship between the ratings and the use of Facebook, the responses of participants were very diverse. 40% of the students indicated that the grades obtained in the school depended a lot on the time they spent socializing on Facebook. On the other hand, 37% of the students commented that there was no relationship between the time spent in the social network and the grades. For these students, getting good grades was not about investing time in different activities, such as Facebook, but focusing on getting good grades. Some students even mention that the use of Facebook has a positive effect on grades thanks to the communication between them and their teachers.

Another factor that may also be a complement to this limitation is the fact that all participating students are first-degree students, and many of them have never participated in research-based surveys. This little experience of participation in studies may be the reason why, in some of the open survey questions, the students' answers did not fit what was asked.

6.3 Some negative results

Ninety three percent of students disagreed that Facebook could not be an effective virtual environment that facilitates the practice and learning of physics. In terms of teaching photovoltaic theory, 7% of students expressed that the environment offered by the virtual platform of Facebook is not appropriate for such subjects. This percentage of students may be in the category of digital immigrants and therefore are not very sure how to handle the virtual environment. Unfortunately, there were not any sign of requesting aid to suing Facebook. Everything was under control by student, at least, it was the scenario. Among these students, there were comments which expressed thoughts such as "the study of physics has to be in a traditional way a teacher explaining the subject and students taking notes on paper.". Again, only small complaints surrounded by students, nothing formal addressed to instructor.

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Some researches had point the lack of motivation about the student toward the showing real affection after participation on research related questionnaires. Students lack of motivation for assessing a self-regulation class (Pintrich, 2004). Final comments were delivered by student in a lack of commitment fashionable way. In other words, they sound as “wherever” there is my output. Motivational attitude is important for any king of experiment with any doubt, unfortunately, the environment proposed for this experiment didn’t work in the support through all long experiment.

Another issue to understand is the allowance of the internet capable devices in the classroom. At the time when the students where interacting within the experiment, the lecturer often don't know if the device is being used for academic purpose compressed a self-regulated learning strategy like writing, taking notes etc. or the device was being used for additional purpose aside the educational. Unfortunately mobile devices also bear a potential for distraction (Gehlen-Baum & Weinberger, 2012). As mentioned before there are many studies pointing how the use of mobiles devices use for learning purposes deviate sometime the behavior of students at study time.

Probably the deviation from its original purpose in the use of Facebook was the point on which the negatives constraints were developed. We need to rethink in some fashion that the producer of Facebook doesn't have any interest in the different attributes that the virtual social network has aside of its purpose. So then, they won't be committee to de development of any situation to develop a better supporting situation for academic purpose. The final stage for Facebook by developers is the enhancing of the platform for commercial purposes only.

6.4 Suggestions for future research

Definitely, this experiment was a rich experience finding elements for the seeking of a new referential framework capable to support nontraditional learning styles. But unfortunately, there were still some constrains that were not satisfied at all. Personally, I believe that the urgent attack to dissolve these kinds of obstacles is definitely a priority for a researcher covering this investigation line.

A solid methodology to support the Instrumental Genesis Theory and the seeking of new methodologies for the study of physics through the Facebook Platform are without any doubts,

the elements that will reinforce the strength of the new framework pointed for the new contemporary students.

In this study, we investigated the perceptions that freshman students have of using Facebook as an academic platform. In addition, students wagered to know the instrumental schemes that students develop in order to be able to use at an optimal instrumental level this Facebook platform. The lack of understanding among students about the difference in the use of the platform in an academic or social way is an urgency that we must cover in a closer way. This is, more research is needed on the necessary elements for students to grasp the instrumental moment. For example, leaving the academic part of using Facebook and taking back the part of virtual socialization - to understand the dividing line between acting academically and socially when interacting on Facebook.

It is proposed for other future studies to find strategies or perceptual methodologies that lead us to a better understanding of the evolution of Facebook use when creating possible use schemes generated from the interaction with the Facebook tool. In this way, observations would take a different organization and also the extraction of more valuable data would be a simpler act. Perhaps, an interesting approach would be the application of instrumental genesis in a perceptive way to the point where our observations are originated from an orderly or instrumented point of view.

On the other hand, the lack of understanding and interest on the part of the academic community over this issue makes this document a call for the continuation of the search for elements that help us to better understand the theoretical framework of learning for our new students. It is suggested to implement a formal physics class with the use of pay tools offered by the Facebook platform. Under this perspective, a common denominator was the lack of more robust

experiments that could give us a broader picture of the difficulties or successes induced by Facebook when using it academically. It would be interesting to develop a complete Physics course in a virtual way on the Facebook platform. So, it is suggested to search the bases for the complete application of Physics courses on the Facebook platform.

As we can see, the variety of applications of the social network Facebook beyond the purpose still contains potential for the search elements that strengthen a new theoretical framework of learning of physics. We hope that this experiment will be useful to inspire and also support the thesis related to this research field.

Surely, with the passing of the time, we will be finding elements that will help us to discern with more caution the application of the social network of Facebook in an academic way but for the moment only remains to recommend the situation comprehended by this experiment.

6.5 Conclusions

This study is considered as the continuation of different previous efforts to find the necessary elements in the use of digital tools. It aims to improve the theoretical framework in which contemporary students are being exposed in the learning of physics at current times. In this study, students' virtual practices in using Facebook as a virtual learning tool were considered. Also, finding instrumental elements of the instrumental Genesis order developed by the practice itself at the time of using Facebook as a virtual educational tool. These instrumental elements could reflect a better understanding of the same use of the virtual platform in a formal way for the learning of Physics. Finally, students' satisfaction of using Facebook as a virtual platform after experiencing the learning of photovoltaic theory through this route.

There are different studies about Facebook in which direct relationships are found between the virtual platform and the students called digital natives (Lei, 2009). In addition, several studies

show that most people, when exposed to technology, experience some instrumental situation to give properties to this device and take it to a point where it can be an instrument (Trouche, 2004). In this experiment, the case of the digital natives was visualized reflecting a complicated situation and causing controversy. Some authors reflect some concern when researching about the instrumental schemes learned during the act of digital natives exposed to a situation of the use of technology, commented that technology would seem to be part of them (Prensky, 2001).We can also see in other experiments the great relationship that exists between digital natives and technology for example (Kennedy, Judd, Churchward, Gray, & Krause, 2008), mentions a great potential for the use of technology in the new generation of students. In studies have found relationships that suggest that digital natives obey to another type of instrumentation when acting with technology (Ardila, 2011). Recent papers have discovered a relationship of another level in how contemporary students interact with technology, considering it as something "born" of this generation (Buckingham, 2008). In Ahedo & Danvilla (2013) suggests the use of Facebook as a social platform and also as an educational platform, since the native digital students feel a degree of comfort when interacting in the social network with virtual platform. There is a great relation about the characterization coming from diverse investigations, of the new contemporaries students in their social practices. So, the answers generated by this experiment kept a line very close to the characterizations previously realized in a diversity of investigations about these digital natives. This indicator puts us in a primordial situation to coincide that the results cover the context of the digital natives.

The results of this research show that there is a great acceptance of Facebook as a virtual learning platform by students participating in the study. This students' conception on Facebook indicates that its application goes beyond being the most popular social network in the world,

but also maintains intricate elements that enable Facebook to support the study of photovoltaic theory in a virtual environment.

Within the dimension of instrumental genesis, the experiment showed no significant relationship to the instrumental processes developed when using Facebook as an academic learning tool. Sizing the instrumental genesis in two ways, the experiment showed that the process of instrumentalisation obeys different areas not the generated when the student is exposed to Facebook in an academic way. Concepts, variations, and modes of use were conceived in a way prior to the moment of use of Facebook academically. There are two resources valid in demonstrating the process of instrumentalisation, the first contributes to the conceptions about the contemporary students called digital natives, reiterated in this experiment. The second resource in the adaptation of the instrumentalisation process originated by the student previously. This phenomenon occurred at the time of using the virtual platform of Facebook in a social way.

The second dimension of the Instrumental Genesis is conceived over the process of instrumentation. The discovering of scheme of use to be enfolded among the existing ones for a rapid insertion and in this way, turn the artefact into a valuable tool. So, this way, the use of Facebook will be handled instrumentally, then after, it will be embedding into the student in order to facilitate the learning of the Photovoltaic Theory virtually. As this is the case, this experiment did not give us enough vision to discover factually data to support this argument. There was not any conceiving of new elements –scheme of use- that students were able to incorporate for the use of Facebook in a new academic fashion. Developed data portraits a different dimension which make us to back up some other investigation statements. Digital Natives are natural at the time that they are expose to technology.

At the end, students' perception about the experience of using Facebook as a learning tool with a competitive platform that supported the learning of the photovoltaic theory virtually was satisfactorily positive. The change of perception about the use of Facebook as a virtual learning tool was null. In this document, there were no elements that indicate that the students who participated in the experiment changed his/her mind after completing the learning experience through Facebook. Only a few students commented that the experience was totally different from what they had in mind but still found elements that endorsed the idea of using Facebook academically.

Expectation about the potentiality of academic intrinsic elements by Facebook as virtual learning platform as well as the potential of avoiding instrumentation steps at the time of using Facebook as virtual learning tool are the great assets offered by this tool. From now, the recommendation for Facebook to be implemented in an alike mode as we advise at this experiment is truly endorsed.

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Appendix A: Results Tables

Table 1 The Internet and Academics.

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Internet distracts me from studying/doing schoolwork.	50	15	15	1	7	12
I use the Internet to procrastinate when I should be studying/doing schoolwork.	50	21	2	6	15	6
The time I spend on the Internet takes away from studying/schoolwork time.	50	25	16	2	5	2
If the Internet did not exist, I would get a lot more studying and schoolwork done.	50	7	21	4	8	10
I have missed a class because I was on the Internet.	50	0	0	5	40	5
I would be getting better grades if I spent less time on the Internet.	50	15	10	10	3	12
My grades are suffering because of my Internet use.	50	20	5	7	17	1
I am able to control my use of the Internet so that it does not interfere with studying/doing schoolwork.	50	4	17	3	20	6
When I am doing research for a course, I primarily use the Internet as a source of information	50	19	5	11	9	6
Overall the Internet has had a positive impact on my academic performance.	50	20	4	1	3	22

Table 2: Facebook and Academics

Survey y Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Facebook distracts me from studying/doing schoolwork.	50	5	12	14	6	13
I use Facebook to procrastinate when I should be studying/doing schoolwork.	50	7	13	9	10	11
The time I spend on Facebook takes away from studying/schoolwork time.	50	4	11	15	15	5
If Facebook did not exist, I would get a lot more studying and schoolwork done.	50	14	8	5	14	9
I have missed a class because I was on Facebook.	50	12	2	14	7	15
I would be getting better grades if I spent less time on Facebook.	49	18	12	4	2	13
My grades are suffering because of my Facebook use.	50	12	3	12	13	10
I am able to control my use of Facebook so that it does not interfere with studying/doing schoolwork.	50	8	13	6	12	11
I have had to wait for a computer at the TECH Center or library because other students were on Facebook.	50	11	23	1	9	6
I use Facebook to communicate with classmates about course related issues.	50	16	8	10	2	14

Table 3: Facebook Use.

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Facebook has become part of my daily routine.	50	8	14	11	8	9
I log on to Facebook and check it regularly whenever I am on the computer.	50	2	6	12	1	29
I lose track of time when I am on Facebook.	50	11	8	17	8	6
I have tried to cut down on my Facebook use.	50	16	2	6	15	11
I would be upset if I were no longer able to use Facebook.	50	7	13	5	14	11
Sometimes I go on Facebook while I am in class.	50	15	15	13	1	6
When I am not on Facebook I find myself wondering what I am missing.	50	18	10	1	12	9
I think I might be addicted to Facebook.	50	13	13	8	16	0

Table 4: Internet use.

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I lose track of time when I am on the Internet.	50	12	15	3	6	14
I have tried to cut down on my Internet use.	50	21	2	6	15	6
I would be upset if I were no longer able to use the Internet.	50	25	16	2	5	2
Sometimes I go on the Internet for personal reasons while I am in class.	50	7	21	4	8	10
I think I might be addicted to the Internet.	50	0	0	5	40	5

Table 5: Enquiry about conceptions

Survey Questions	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you believe that Facebook offers a virtual environment for the learning of the photovoltaic theory?	50	32	5	8	5	0
Do you believe that Facebook is able to go beyond over its purpose and help you to enhance your academic performance?	50	19	2	6	15	0
I agree that the academic purpose of Facebook is a strong tool that all academic institution must use for academic purposes?	50	22	16	2	5	0
Do you believe that Facebook have a stronger relationship with your academic performance?	50	16	21	4	8	0
Do you recommend the use of Facebook for academic purposes?	50	12	0	5	40	0
Do you believe that Facebook is the best platform for learning online?	50	32	10	10	3	0
Do you believe that Facebook has the proper tool to support the leaning of Physics in a virtual environment?	50	19	5	7	17	0
Do you believe that academic learning over the Facebook platform is very difficult?	50	18	17	3	20	0
The use of Facebook academically can help you to upraise your grades?	50	6	5	11	9	0
Is Facebook the next big thing on academics?	50	20	4	1	4	16

Table 6: Percentages of Time spent on studying and doing schoolwork

		Time spent per day						
Activity	n	30 min	1 hr.	2 hr.	3 hr.	4 hr.	5 hr.	6 hr.
Schoolwork	50	28.4	32.6	12	16.2	6.4	1.5	2.9

Table 7: Technological Devices Used to Access the Internet

technological device(s)	n	%
Laptop	19	38%
Laptop and Handheld	5	10%
Desktop, Laptop, and Handheld	5	10%
Desktop and Laptop	15	30%
Desktop	3	6%
Desktop and Handheld	3	6%

Table 8 Percentage of internet and Facebook Uses Frecuencies

	Internet (n=50)	Facebook (n=50)
Frecuencia	%	%
Once a week	0	0.5
Once a day	1.2	3.6
2 times per day	3	12.5
3 times per day	18.5	25
4 times per day	19.5	18.3
5 times per day	35.5	14.5
6 times per day	19.8	19.2
Other (please specify)____	2.5	6.4

Table 9: Percentage of time spent on the internet and Facebook

	Academic		Recreational	
	Internert use (n=50)	Facebook use (n=50)	Intenet use (n=50)	Facebook use (n=50)
Frequency	%	%	%	%
30 minutes or less	2.5	3	2	5
1 hr.	4	5	5	19
2 hrs.	15.5	16	14	15
3 hrs.	25	12.5	15	25.5
4 hrs.	14	14	12.5	12.5
5 hrs.	12.5	15.5	15	12.5
6 hrs.	14.5	24.5	20	10.5
More than 6 hrs.	12	9.5	16.5	0

Table 10: Percentage of delay of Facebook Use

Frequency	n	Mins	5 Mins	15 Mins	30 Mins	45 Mins	1 Hr.	2 Hrs.	3 or more Hrs.	
Delay	50	12.5		15.5	21	26	8.5	10.5		6

Table 11 Percentages of Three Most Common Facebook Activities

Facebook activity	Activity one %	Activity two %	Activity three %
Talk to friends via chat, private messages, wall posts	10.5	16.30	17.66
Read news feed	30.5	16.30	0.52
Check notifications	12	16.30	4.42
Look at photos	18	16.30	0.26
Look at friends' pages/profiles	5	16.30	15.06
Check/update page/profile	1	16.30	18.18
Check friends' statuses	2.5	16.30	11.69
Update status	4	16.30	8.57
Comment on friends' photos, statuses, posts, comments	9	16.30	18.18
Use applications (play games, listen to music, shop marketplace)	7.5	16.30	5.45

Table 12: Percentages of Internet and Facebook Attitudes

Attitudes	%
Internet positives (n = 50)	
Convenience and access	32.63
Useful for academic purposes/finding information	25.61
Facilitates online social interaction/connection	12.63
Fun and entertaining	29.12
Internet negatives (n = 50)	
Procrastination, distraction, addiction, time wasted/displaced	21.08
Privacy issues and cybercrime	17.03
Slow connections/technical difficulties	10.27
Reduces in-person social interaction	26.76
Unreliable and/or inaccurate information	24.86
Facebook positives (n =50)	
Facilitates online social interaction/connection	21.18
Allows me to see what friends are doing	32.64

Fun and entertaining	24.65
Useful for academic purposes/communicating about class work	21.53
Facebook negatives (n = 50)	
Procrastination, distraction, addiction, time wasted/displaced	29.53
Privacy issues and cybercrime	17.45
Negative online social interactions	2.01
Narcissism and exhibitionism	51.01

Table 13: Post-conceptions about the use of Facebook academically

Survey questions.	n	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you have a positive experience during the learning of the PV Theory under Facebook environment?	50	42	6	1	0	0
Facebook offers all necessary to support a learning experience.	50	39	2	6	3	0
Facebook should be using more often for academic purposes.	50	25	2	18	5	0
Facebook is able to support a learning environment for teaching physics.	50	47	3	0	0	0
I will recommend the use of Facebook for academic purposes to others professors.	50	40	10	0	0	0
The use of Facebook as academic tool is for the exclusive use of the learning of Physics.	50	0	0	10	39	1
My grades are better because I use Facebook for the learning of the PV theory.	50	2	12	30	0	6
The best way to learn Physic is with the aid of Facebook.	50	4	19	23	0	4
Facebook offers a useful and meaningful educational environment able to support, enhance or strengthen the learning of Physics	50	41	8	1	0	0

Table 14:

Inquiry questions about instrumentation	**1**	**2**	**3**	**4**	**5**
How do you consider your experience in using Facebook as a technological learning tool?		7	10	15	18
You needed new elements to manage the Facebook platform when using it as a technological learning tool and not as a social network.	1	6	19	26	4
Your experience in using Facebook as a virtual platform in an academic way was very good.				8	42
The tools offered by the Facebook platform are optimal to be able to use it as an academic platform				46	4
The Facebook platform needs more elements that are specifically developed for academic tasks	5	40	5		
This learning task helped you develop certain skills in the use of Facebook that will be useful in the use of this platform in a more orderly and different purpose from which it was created.	46	4			
You will never use the Facebook platform for any other use other than for the social network	50				
Were there any different skills you had to develop to use the Facebook platform as a learning source? Please comment on what they were. (Open)					
It explains the difference between the skills required to use the Facebook platform as a learning tool and as a social communication tool. (Open)					