competitiveness
for industry, science and education

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Determinants of mobile-learning as a conceptual model of learning innovation for higher education in Guadalajara metropolitan area, Mexico

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Abstract

The information and communication technologies *(ICT)* are producing new and innovative forms of teaching-learning process in higher education, so our research question is: *Which are the determinants of Mobile-Learning as Conceptual Model of Learning Innovation for higher education in Guadalajara Metropolitan Area, Mexico?* This research is aimed to respond it, based on documentary study to select the variables with *5* specialists in mobile-learning *(mL)* from Guadalajara Metropolitan Area, Mexico using Analytic Hierarchy Process *(AHP)*.

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The final *determinants* were: the Professor *(P)*, the Student *(S)* according its role; the Contents *(C)*; the Technology *(T)* with a *Final Questionnaire* designed with *60 Indicators* grouped, according the principal authors to describe *mL*.

Keywords: mobile learning, conceptual model, learning innovation, Mexico.

Abbreviations

Abbreviation	Description	Descripción
AHP	Analytic Hierarchy Process	Proceso Analítico Jerárquico
C	Contents	Contenido
CFA	Confirmatory Factorial Analysis	Análisis Factorial Confirrmatorio
CTLM	Contents Teaching-Learning Management	Contenido Administración Enseñanza-Aprendizaje
CTLS	Contents Teaching-Learning Styles	Contenido Estilos de Enseñanza-Aprendizaje
EFA	Exploratory Factorial Analysis	Análisis Factorial Exporatorio
ICT	Information and Comunnications Technologies	Tecnologías de Información y Comunicaciones
mL	Mobile Learning	Aprendizaje Móvil
P	Professor	Profesor
PIMS	Personalized Intelligent Mobile Learning System	Sistema Inteligente de Aprendizaje Personalizado
PSAA	Professor-Student Assessing Activities	Profesor-Estudiante Evaluación de las Actividades
PSAP	Professor-Student Assessing Participation	Profesor-Estudiante Evaluación de la Participación
PSAQ	Professor-Student Assessing Quality	Profesor-Estudiante Evaluación de la Calidad
PSPF	Professor-Student Perception Feasibility	Profesor-Estudiante Percepción de Facilidades
PSPO	Professor-Student Policies	Profesor-Estudiante Políticas
PSPVC	Profesor-Student Perception Value/Cost	Profesor-Estudiante Percepción del Valor/Costo
P&S	Profesor&Student Rol	Profesor-Estudiante Rol
RQ	Research Question	Pregunta de Investigación
S	Student	Estudiante
SEM	Structural Equations Modeling	Modelo de Ecuaciones Estructurales
T	Technology	Tecnología

Abbreviation	Description	Descripción
TASY	Technology Asynchronous Communication	Tecnología Comunicación Asíncrona
TFRN	Technology Friendliness	Tecnología Amigabilidad
TMMD	Technology Multimedia	Tecnología Multimedia
TSME	Technology Social Media	Tecnología Redes Sociales
TSYC	Technology-Synchronous Communication	Tecnología Comunicación Síncrona
ZPD	Zone of Proximal Development	Zona Próxima de Desarrollo

Source: Own.

Introduction

The projected growth of education supported by ICT, responds immediately to resolve problems of geography, time and demand. Unfortunately, it has also drawbacks, such as: low intensity on interactivity between professor-student; feedback tends to be very slow; It presents difficulties error correction materials, assessments; there are more dropouts than face teaching; etc. (Gallego and Martinez, 2002). E-learning or online, is defined by the Fundación para el Desarrollo de la Función Social de las Comunicaciones (Fundesco) as: *a system for delivery of distance learning, supported by ICT which combines different pedagogical elements: classical training (classroom or self-study), practical, real-time contact (in person, video or chat) and deferred contacts (tutor, forums discussion, email)* (Marcelo, 2002). In the second decade of this century, due to technological advances, we have a growing number of mobile devices, from smartphones to notebooks, notepads, iPads, tablets in general, etc. even stopping the development of the PC. Even more, according Adskins (2013) *the growth rate for Mobile Learning products and services in the Latin America region is 32.5%, second highest regional growth rate in the world after the Africa region. Revenues will more than quadruple from the $362.3 million reached in 2012 to a staggering $1.4 billion by 2017...for México, is expecting a growing more than 35%*; finally, *a third of the tablets sold in 2016, will have serious purposes for education issues* (Kaganer et al., 2013). There are several evidences of how m -Learning Improves different educational aspects, in undergraduate students, such as the study of Alexander (2006), Chih-

Ming & Shih-Hsun (2008); Ramos (et al., 2010). Hence, we propose the following Research Question (RQ): *¿Which are the determinants of mobile-learning as conceptual model of learning innovation for higher education in Guadalajara Metropolitan Area, Mexico?*

Methodology

We made a documentary study of mL main factors, among more than 100 works in this regard, proceeding to detect all the variables what are more often mentioned, and by means of AHP (Saaty, 1997) technique, we asked to 5 specialists in m-Learning from Guadalajara Metropolitan Area, Mexico to select the most important variables to use in our conceptual model further discussion. See Table 1.

Table 1
AHP or Saaty's Theorem

Objective	Mobile Learning (mL)			
	Variable		*Frecquency*	*AHP weighing*
	1	Technology	28	0.23
	2	Contents & Teaching Learning Management	16	0.22
	3	Professor	12	0.19
	4	Student	10	0.13
Alternatives	5	Innovation	9	0.07
	6	Assessing	8	0.06
	7	Policies	7	0.04
	8	Learning Management	3	0.02
	9	Web Learning	4	0.01
	10	On Line Communities	1	0.01
	11	Multimedia Learning Objects	1	0.01
	12	Augmented Reality for learning	1	0.01
Total			100	1.00

Source: own.

Results and discussion

Evidences about how mL improves the conditions of the environment of education. We have, for instance, the study of Alexander (2006) who considers the older spaces take on new pedagogical meaning. Moreover, since this technology is mobile, students turn *nomad,* carrying conversations and thinking across campus spaces. We have other results with the Chih-Ming & Shih-Hsun (2008) research about how to enhance the environment for English learning, adopting the advantages of the mobile learning to present a personalized intelligent mobile learning system (PIMS) successfully implemented devices for mobile learning for promoting the reading ability of English news. Or the Ramos (et al., 2010) research that presents a multiple case study carried out when mobile learning mL was first introduced to 3.000 freshmen of two university campuses in Mexico, to identify how they help develop cognitive skills in students. The results show that by using mL resources it changes the learning environment by converting any setting into a collaborative and innovative environment. Also it was found that although students are not aware of it, mL resources and the use of mobile devices assists them in developing strategies that promote cognitive skills such as problem solving, decision making, critical thinking, creative thinking among several studies.

Learning Innovation. Lundvall and Soete (2002) argue about the education systems, that people learn specific ways of learning. So, creativity is the first condition for innovation that schools should encourage. The challenge then, is to develop the conditions that favor the development of divergent ideas which, in turn, feed innovation experiences to learn in the schools (Marcelo, 2002).

Learning Management. There are several theories that attempt to explain how people learn. Over 50 ubicables theories are online; however, most of them are variations of the 3 main lines*: behaviorism (behavior), cognitivism (mind and brain) and constructivism (construction of knowledge).* New theories are evolving around the mL such as: *connectivism (network connections)* and *enactivism (actions based on the body and senses,* Woodill, 2011).

mL. Since the focus has shifted in recent years due to technological advances, so does its definition; see Table 2.

Table 2
m-Learning Descriptions

Author	Description
Brazuelo y Gallego, 2011	*"...The educational model that facilitates the construction of knowledge, problem solving learning and development of skills or different skills autonomously and ubiquitous thanks to the mediation of portable mobile devices".*
Traxler & Kukulska, 2005	*"...Any educational process where the only dominant and prevailing technology is provided by equipment type: handheld or palmtop ..."*
Keegan, 2005	*"...m-Learning should be restricted to devices based learning where anyone can carry in their pockets"*
O'Malley et al., 2005	*"...Any sort of learning that happens when the student is not fixed, or at a predetermined place ... well, is learning happens when students take advantage of the learning opportunities offered by mobile technologies"*

Source: several authors by own adaption.

Consultant or professor tells the students what to do in their learning; in other words, they become in *facilitators* that make the student achieves higher levels of knowledge (Woodill, 2011).

The Contents. People perceive e-learning as a formal course, and not as a tool and an attitude towards lifelong learning to keep the own learning suggests about to get better perceptions of m-Learning innovation with new didactic materials, improvements in their presentation on a large scale, (Cabero, 2012) as shown in Table 3.

Table 3
Differences between Learning Centered in: Content and Activities

Learning Centered Content	Learning Centered activity
The student is usually reactive and passive, waiting for what the professor says or decides.	Students have an active involvement in their learning, without waiting for the professor to decide for them;
Decision space student, is small.	Broad freedom for students and space for own decisions as important elements of their learning.
Individual learning is promoted	Learning is promoted in collaboration with colleagues; students have opportunities to be independent in their learning.
Students do not have many opportunities to learn independently.	Process-related skills, with a focus on results, and the search, selection and management of information.

Learning Centered Content	Learning Centered activity
Memory replication of content and skills. Personal and professional education often is limited to certain periods of life	Personal and professional education throughout life.

Source: Cabero, 2012, by own adaption.

According to Cabero (2012), an important design aspect is that, there are several types: ranging from the methodologies and strategies that will be used in the virtual action (training design), the type of navigation that allows within materials (navigation design), the chances of students, professor relationship (interaction design); graphic forms in which present the information (navigation design), different evaluation strategies to be permitted and used in the training (evaluation design), and ways of presenting content with forms of construction (design of content).

The Student (S). This topic takes into account, the cognitive, memory, prior knowledge, emotions and possible motivations. The student will assume the commitment with his own learning process and will find out, in the self evaluation the key to discover his own progress, to make choices. (Montoya, 2008); see Table 4.

Table 4
Variable: Student Requirements

Variable	Example/Description	Comments	Source
Previous Knowledge	Tacit and explicit knowledge stored in memory with conditions to be applied in the teaching-learning process	This impacts in how the students are understanding new concepts	Driscoll (2005); Tirri (2003)
Memory	Techniques to successfully encoded with use of signals such as: categorization, mnemonic, tactile, auditory, sensory, etc.	It involves, how multimedia actively encourage the students in their learning	
Context & Transference	Static Knowledge vs Dynamic Knowledge	It involves, how to make students use what they learn to strengthen the memory, understanding and transfer the concepts to different contexts.	Carroll & Rosson, (2005); Driscoll (2005)

Variable	Example/Description	Comments	Source
Learning by Discovering	Application procedures and concepts to new situations; case study	It involves, how to encourage students to develop skills to filter, select and recognize relevant information in various situations	Tirri (2003)
Emotions & Motivations	Student's feelings to perform a task; reasons for their achievement.	Student inclination or ability to adopt an attitude that prepares your emotional state or desire to accomplish a task.	Carroll & Rosson, (2005) ; Tirri (2003)

Source: several authors, by own adaption.

Hence, it described how students use, what they already know and how the information is encoded, stored and transferred; It covers theories about the transfer of knowledge and discovery learning (Carroll and Rosson, 2005). The experience and prior knowledge, affect learning as does the atmosphere of the student. So their application is under the *experiential memory* (Driscoll, 2005). So, it is important the teaching style of professors. They are, explicitly or implicitly, using observation techniques, try to *know their* students (Gallego & Martínez, 1999), discovering *learning styles*. See Table 5.

Table 5
Learning Styles

Learning Styles	Description
Activist	Students are fully and without prejudice involved in new experiences. They are grown to the challenges and get bored with long maturities. They are people very group who engage in the affairs of others and focus around all activities
Reflexive	Students learn the new experiences but do not like to be directly involved in them. Collecting data, analyzing them carefully before reaching any conclusions. Enjoy watching the actions of others, listening but not intervene until they have taken over the situation.
Theoretical	Students learn best when they are taught about things that are part of a system, model, concept or theory. They like to analyze and synthesize. For them. if something is logical, it is good.
Pragmatic	Students apply and practice their ideas. They tend to be impatient when people who theorize

Source: Honey y Mumford (1992), by own adaption.

The Professor (P). The concept of Vygotsky (Moll, 1993) having greater recognition and applicability in the educational field is the zone of proximal development (ZPD). This concept *means the individual's actions that he can perform successfully start only in interaction with others, in communication with them and with their help, but can then play in totally autonomous and voluntarily* (Matos, 1995). They are responsible for designing strategies that promote intensive interaction, taking into account the previous level of knowledge of students, from the culture and the meanings they have in relation to what they will learn(Onrubia, 1998). The process is established where a group of professors together: design, teach, observe, analyze, and review one class lesson. See Table 6.

Table 6
Professor Requirements

Indicators	Example/Description	Comments	Source
Informatic Culture	Permanent update of information by using of technology	Attitude and intuitive ability to learn the use of technological resources	Ng & Nicholas (2013); Cabero, 2012
Lection Cycle	Groupal planning / experimental lection/ individual reflection / groupal reflection/ lection refomualeted	Teaching based on enactivism	
Cognitive Objectives	Bloom's Digital Taxonomy	Association with the enactive cognitive objectives, such as teaching: knowledge; comprehension; the application; analysis-synthesis and evaluation.	Bloom, 2012

Source: several authors by own adaption.

The Technology (T). It is considered under the pedagogical aspect of how the *intrinsic features* of the equipment must gather and have intrinsic features such as: *ergonomics, portability, weight, size, weight, design, speed of access to the telecommunications network, processing, storage, capacity growth* and the *extrinsic features* of the equipment, based on provider of telecommunications services such as: *coverage, price, speed of access, availability, compatibility of protocols* among

other features are aimed to improve the teaching-learning process (Shneiderman and Plaisant, 2005).

Policies & Assessing. In order to guarantee the continuity and implementation of mL technology, is necessary to develop institutional policies to provide direction and enough resources to achieve it, included an assessment system to verify since the participation until the activities and quality of the teaching actions and course contents (Garrison & Anderson, 2003). See Table 7.
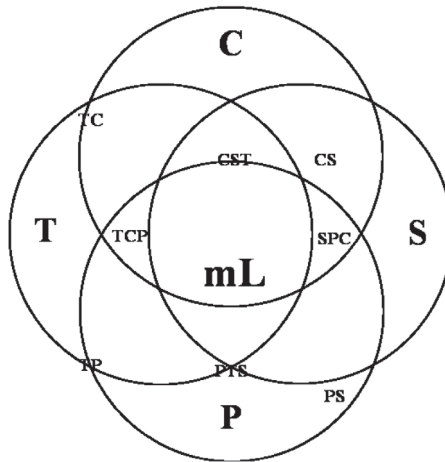
Table 7
Topics that a policy document and strategic plan should include

1. Vision: – understand background– define core values– describe strategic goals
2. Needs and risk assessment:– identify issues– identify challenges – identify best practices
3. Educational principles and outcomes described
4. Implementation initiatives and strategy: – link to institutional priorities– create a steering committee – identify communities of practice
5. Infrastructure: – design multimedia classrooms– describe administrative processes
6. Infostructure: – design institutional connectivity– create a knowledge management system– provide digital content– create standards
7. Support services: – provide professional development– provide learner support
8. Budget and resources
9. Research and development framework
10. Benchmarking: – establish success criteria– assess progress– communicate direction and accomplishments
11.Assessing

Source: Garrison & Anderson(2003), with own adaption.
According above, we propose the following Figure 1.

Figure 1
Determinants of Mobile-Learning as Conceptual Model of Learning Innovation for Higher Education in Mexico

Notes: Variables: P. Professor; S. Student; C. Contents; T. Technology; Intersection double area Variables, are: TC; CS; PS; TP; AD; DT; TC; Intersection double area variables, CST; SPC; PTS; TSP.
Source: Own.

Results

Table 8 shows the Final Questionnaire with: 3 Factors, and 60 Independent Variables grouped, according the principal authors to describe mL.

Table 8
Final Questionnaire

F5. Factor: Mobile Learning (mL)

Personal Background

If you are a Student: Name of the (mL) course; -What is your occupation? Manager/Employee non-technical/ Employee technical/Teacher or trainer/ Student; -How old are you? 24 or younger /25-29 /30-40 /41-50 / over 50;
-Gender? Female / Male; -What is your level of education? High school matriculation/ One to three years of post-secondary education / Four or more years of post-secondary education; -Personal Digital Assistant (PDA) ownership – Do you own? Smartphone/Lap/Palmtop/ Other; - Where did you study the mobile learning course? At home/ At the office or work/ While travelling/ Other.
If you are a Teacher: Name of the (mL) course;-What kind is your assignment? Social Sciences/ Engineering;
-Are you: Instructor/ Assistant Professor/ Associate Professor/ Professor;-How old are you? 24 or younger /25-29 /30-40 /41-50 / over 50;-Gender? Female / Male; -What is your level of teaching? High School/ Undergraduate/ Postgraduate/ ;-Personal Digital Assistant (PDA) ownership – Do you own? Smartphone/Lap/Palmtop/Other;-Where did you study the mobile learning course? At home/ At the office or work/ While travelling/ Other

Factor	*Variable (measured by Likert Scale: Strongly agree/ Agree/ Uncertain / Disagree/ Strongly disagree)*	*Author(s)*
	D1. Technology Friendliness (TFRN)	
Technology (T)	V1.-I need a special training to use my PDA	Ng & Nicholas (2013)
	V2. The screen on the PDA makes it difficult to do my school work.	
	V3. Writing with a PDA is easier than writing by hand on paper	
	V4. With a PDA it is easy to take my school work home.	
	V5. I would recommend mobile learning as a method of study to others	Keegan (2005)
	D2. Technology-Synchronous Communication (TSYC)	
	V6. Chat in mlearning is very useful is better than PC	Keegan (2005)
	V7. IP telephony functions are very well with the mlearning course.	
	V8. The sending of SMS is very useful	Ng & Nicholas (2013)
	D3. Technology Asynchronous Communication (TASY)	
	V9. Communication and sending assignments for submission with the students (or tutor) by e-mail functioned well.	Keegan (2005); Ng & Nicholas (2013)

Factor	Variable (measured by Likert Scale: Strongly agree/ Agree/ Uncertain / Disagree/ Strongly disagree)	Author(s)
Technology (T)	V10. Writing messages to the Forum functioned well	Keegan (2005)
	V11. Answering assignments for submission applying the mlearning functioned well.	
	V12. Accessing to notes and reading text functioned well.	
	D4. Technology Multimedia (TMMD)	
	V13. Accessing to sound, video and graphical materials functioned well	
	V14. Activities/assignments involving manipulation of graphical materials functioned well	
	D5. Social Media (TSME)	
	V15. To learn (or teach), I tend to be in different networks, in permanent interaction and collaboration	Woodill (2001)
	V16. To learn (or teach), I tend to participate in : gammings, simulations and/or virtual worlds	
	V17. To learn (or teach), I feel I spend a lot of time connected in different networks with scarce results	
Contents (C)	D6. Teaching-Learning Management (CTLM)	
	V18. Accessing course content was easy	Keegan (2005)
	V19. Communication with and feedback from the student (or tutor) in this course was easy.	
	V20. Mobile learning is convenient for communication with other course students (or teachers)	
	V21. PDAs help me learn (or teach) my subjects better	Ng & Nicholas (2013)
	V22. There are no disadvantages in using PDAs in the classroom.	
	V23. PDAs make learning (or teaching) more interesting.	
	V24. PDAs help me organise my time better.	
	V25. I feel my learning (or teaching) process is more willing to punishment-reward cycle	Woodill (2001)
	V26. I feel my learning (or teaching) process is more willing to the individual internal brain processes such as: memory, attitude, motivation, self-reflection.	
	V27. I feel my learning (or teaching) process is more willing to "learn how to learn" and I select and decide about how they affordable information responds to my needs when I require it.	
	V28. I feel my learning (or teaching) process is more willing to the sensation to be connected everywhere, every time to the internet affordances	
	V29. I feel my learning (or teaching)process is more willing to respond to the perception of the environment and my actions, through experiencing and doing.	

Factor	Variable (measured by Likert Scale: Strongly agree/ Agree/ Uncertain / Disagree/ Strongly disagree)	Author(s)
	D7. Teaching-Learning Styles (CTLS)	
Contents (C)	V30. As a student, (or teacher), I feel that the contents are enough to motivate me to: create new forms of knowledge. You are more Reflexive	Cabero (2012); Bloom (2009); Gallego & Martínez (1999); Honey& Mumford (1992)
	V31. As a student, (or teacher) I feel that the contents are enough to motivate me to: evaluate the knowledge acquired. You are more Reflexive.	
	V32. As a student, (or teacher) I feel that the contents are enough to motivate me to: analyze knowledge acquired. You are more Reflexive.	
	V33. As a student, (or teacher) I feel that the contents are enough to motivate me to: apply the knowledge acquired. You are more Pragmatic	
	V34. As a student (or teacher) I feel that the contents are enough to motivate me to: comprehend the knowledge acquired. You are more Reflexive.	Cabero (2012); Bloom (2009); Carrol&Rosson (2005); Gallego & Martínez (1999); Honey& Mumford (1992)
	V35. As a student, (or teacher) I feel that the contents are enough to motivate me to: memorize the knowledge acquired. You are more Pragmatic.	
	V36. As a student, (or teacher) I feel the contents are well designed considering: text, context, colors, PDA's formats, accesability, etc.	Montoya (2008)
Professor & Student Rol (P&S)	D8. Professor-Student Perception Feasibility (PSPF)	
	V37. I am motivated about using a PDA for mlearning, because is easy to use and I learn (or teach) better with it.	Ng & Nicholas (2013); Driscoll (2005)
	V38. When I use a PDA I am very intuitive using my memory and my senses	Driscoll (2005)
	V39. Navigation through the mobile learning course was easy.	Keegan (2015); Moll, (1993); Woodill (2011)
	V40. For mobile learning (or teaching) to be effective it is necessary to use graphics and illustrations	Keegan (2015);
	V41. Evaluation and questioning in the mlearning course was effective	
	V42. The use of PDAs have more advantages than a desktop computer.	Ng & Nicholas (2013)
	V43. The PDA that I use has a good relation among hardware, software and connectivity network.	Iso/IEC7498; Shneiderman y Plaisant, 2005; Woodill, 2001

Factor	Variable (measured by Likert Scale: Strongly agree/ Agree/ Uncertain / Disagree/ Strongly disagree)	Author(s)
	D9. Professor–Student Perception Value/Cost (PSPVC)	
Professor & Student Rol (P&S)	V44. mlearning increases access to education and training. It is still expensive.	Keegan (2005)
	V45. The cost of accessing the mobile course materials was acceptable.	
	V46. The cost of communicating in the mobile learning course with the tutor and other students was acceptable.	
	D10. Professor-Student Assessing Participation (PSAP)	
	V47. Effectively encourage others to learn?	Garrison & Anderson(2003)
	V48. Contribute regularly, at each important stage of the unit?	
	V49. Create a supportive and friendly environment in which to learn?	
	V50. Take the initiative in responding to other students?	
	V51. Seek to include other students in their discussions?	
	V52. Successfully overcome any private barriers to participation?	
	V53. Demonstrate a reflective approach?	
	D11. Professor-Student Assessing Activities (PSAA)	
	V54. Each of the activities and strategies employed to assess student learning has methodological and epistemological shortcomings.	
	V55. All the student products are stored in a Database of learning products	
	V56. The assessment is based on using problem-based learning (PBL) activities in m-learning education.	
	D12. Professor-Sudent Assessing Quality (PSAQ)	
	V57. As a Student (or Teacher) I evaluate the course objectives, activities, contents, technology affordances are aligned and congruent with the tutoring (or goals) of the course.	
	V58. As a student I evaluate the knowledge acquired vs the initial expectations (If you are a teacher: Do you evaluate the knowledge acquired vs the initial expectations of each student?)	Garrison & Anderson(2003); Woodill (2001)
	D13. Professor-Student Policies (PSPO)	
	V59. I'm informed (If I'm a Teacher: inform to the students), the security and support policies	
	V60. I'm informed (If I'm a Teacher: inform to the students, the educational principles and outcomes described	

Source: Own.

Discussion

We respond RQ showing the Figure 1. Determinants of Mobile-Learning as Conceptual Model of Learning Innovation for Higher Education In México and the Table 8. Final Questionnaire with 60 Indicators. As we see, the first factor T, most be described in pedagogical affordable terms; so, the friendliness of the mL devices are based on the *intrinsic features* of the equipment must gather and have intrinsic features such as: *ergonomics, portability, weight, size, weight, design, speed of access to the telecommunications network, processing, storage, capacity growth* and the *extrinsic features* of the equipment, based on provider of tele-communications services such as: *coverage, price, speed of access, availability, compatibility of protocols* (Ng & Nicholas, 2013; Keegan 2005; Shneiderman y Plaisant, 2005, Woodill, 2001). About C factor, we show the need to be well designed on terms to be accessed (Montoya, 2008), ensuring the communication in both ways P&S, motivating several aspects in education such as: *memorize the knowledge, pragmatic, reflexive or reactive attitudes* (Cabero, 2012; Bloom, 2009; Gallego & Martínez, 1999; Honey& Mumford, 1992; Woodill, 2001; Keegan, 2005; Ng & Nicholas; Carrol&Rosson 2005; Gallego & Martínez, 1999). The P&S rol, is aimed to encourage and acknowledge the advantages that are included in the mobile devices to P&S, involving a dynamic relationship in both parts (Garrison & Anderson, (2003); Woodill (2001); Ng & Nicholas (2013); Driscoll (2005); Keegan 2015; Moll, 1993; Ng & Nicholas, 2013; Shneiderman y Plaisant, 2005). For further studies we recommend the practice of *Exploratory Factorial Analysis* (EFA) to identify different indicators and gather all of them in *dimensions*, according the authors and a *Confirmatory Factorial Analysis* (CFA) to discover other relationships between the underlying factors as we see in Figure 1 in the intersection of double area variables, such as: TC; CS; PS; TP; AD; DT; TC; and the intersection in triple area variables, CST; SPC; PTS; TSP. For instance, the determinant factor T is related with dimension: *Technology Friendliness* (TFRN) assumed from: Ng & Nicholas, 2013; Keegan 2005; *Technology-Synchronous Communication* (TSYC). The dimensions: *Technology Asynchronous Communication* (TASY); *Technology Multimedia* (TMMD); *Social Media* (TSME), assumed from: Keegan (2005); Shneiderman y Plaisant, (2005) and Woodill, (2001). About determinant factor C, we expect to find the dimension: *Teaching-Learning*

Management (CTLM) assumed from Keegan, (2005); Ng & Nicholas, (2013) and Woodill, (2001); the dimension: *Teaching-Learning Styles* (CTLS) assumed from: Cabero (2012); Bloom (2009); Gallego & Martínez (1999); Honey& Mumford (1992); Carrol&Rosson (2005); Gallego & Martínez (1999) and Montoya (2008). Finally, determinant factor P&S Role with dimensions: *Professor-Student Perception Feasibility* (PSPF) assumed from: Ng & Nicholas (2013); Driscoll (2005); Keegan (2015); Moll, (1993); Woodill (2011); Shneiderman y Plaisant, (2005); Woodill, (2001). The dimension: *Profesor-Student Perception Value/ Cost* (PSPVC) assumed from: Keegan (2005). The dimension: *Professor-Student Assessing Participation* (PSAP), *Professor-Student Assessing Activities* (PSAA), Professor-Sudent Assessing Quality (PSAQ), assumed from Garrison & Anderson(2003) and the dimension: *Professor-Student Policies* (PSPO), assumed form), assumed from Garrison & Anderson (2003) and Woodill (2001). We recommend finally the practice of *Structural Equation Modeling* (SEM) as *Confirmatory Factor Analysis*, in order to discover the underlaying relationships among the variables.

Conclusions

The information and communication technologies (ICT) are producing new and innovative of teaching-learning process in higher education in México. This research found a conceptuyal model with the final *determinants,* were: the Professor (P)m and the Student (S) according its role; the Contents (C) and finally, the Technology (T) with a Final Questionnaire designed with 60 Indicators grouped, according the principal authors to describe mL. For further studies we recommend the practice of *Exploratory Factorial Analysis* (EFA) to identify the groups of this indicators in dimensions. We previewed 13 (marked with letter D, in the questionnaire). It's very important to discover precisely how is the relationship of the other underlying indicators, so we propose the *Confirmatory Factorial Analysis* (CFA), through Structural Equations Modeling to get this.

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This book try to integrate different work papers, considering key elements of science applied to industry and education, and how these affect the competitiveness.

Research includes areas where competitiveness makes a big difference to the current economic growth were collected.

Each chapter in this book ranges from marketing tools, strategies for the internationalization of SMEs, innovation in the chemical industry; fields of knowledge such as the improvement in the assessment of higher education without neglecting the importance of the tourism industry, information technology and communication and logistical capacity in the pharmaceutical business.

It concludes with the presentation of research where two factors are major players presently, marketing and social responsibility.

The main objective of this work is to present the last findings about the market advantage, key factor in Marketing, Innovation, Social Network, Business Internationalization, and their impact on competitiveness.