



Norwegian University of  
Science and Technology

# Innovative Methods to improve the Learning.

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Master's Thesis

Submission date: June 2016

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## Preface

This following Thesis represents the final project for completing the Master of Industrial Engineering of the Univesitat Politecnica de Valencia (UPV). The development of the project has been done in the department of Production and Quality (IPK) of Norwegian University of Science and Technology (NTNU) with the help of the program of exchange of study ERASMUS. The project aims to research about the impact of innovative methods of learning, especially education in distance.

I have taken efforts in developing this report; however, it would not have been possible without the support and help of many individuals to complete it. I am using this opportunity to declare my gratitude to all those who supported me during the research and those who decided to share their time providing us with valued information through surveys and interviews.

I would like to express my special appreciation and gratitude to Professor Bassam Hussain, who supported this researching throughout its development and trusted me during this work. He offered me the opportunity to join to this amazing project and incorporate in the department of Production and Quality (IPK) as student assistant. I am thankful for his aspiring guidance and advice, which were vital to fulfill this project. He is a great professional who have taught me so many things that I will never forget.

I would like to express my special appreciation to Ruben Ravnå for his technical support and lesson about software tools. He explained me how Skype for Business works and the interconnections of its different components.

Finally, I would like to thank my parents Mercedes Barrado and Jesus Nieto, my brother Luis Nieto and Naiara Pardo for their supports not only through my study but through my whole life, encouraging me not to give up and continue fighting for all I want achieve.

Jorge Nieto

Trondheim, June 2016



## Summary

Innovative methods is a concept that includes those methods in which the multimedia plays an important role. This investigation explores the impact of these innovative methods on the educational environment. Due to the high variety of innovative methods and the impossibility to analyze experimentally all of them, we have focused our research in combined method. Combined mode develops the lecture combining traditional and distance methods. In this way, students have the chance to attend to the class face-to-face or watching the lectures online.

The research was done using a qualitative approach through surveys and interviews conducted with teachers and students. The findings show the level of learning, engagement and the main barriers o using combined mode.

Thanks to the high quality of the new technological equipment installed, the resolution of the video allows students to achieve the same level of learning and understand the new concepts as if they were attending to the classroom.

Engagement is the capacity to involve students in the participation of the lecture and be active components. It facilitates to ask questions typing them in distance help online students in the resolution of doubts, allowing them to solve problems and participate actively in the classroom.

Rather than analyzing the level of learning and engagement, the thesis researches about the main barriers that students have found during the development of online classes by combined mode, proposing solutions to solve the connectivity problem and improve the blackboard visualization.

Keywords: Traditional methods, Active methods, Innovative methods, Combined method, learning, engagement.



## Table of Contents

Preface.....	1
Summary.....	3
List of Figures.....	7
List of Tables .....	8
1. Introduction.....	9
1.1 Background .....	9
1.2 Scope of work .....	10
1.3 Objectives.....	11
1.4 Challenges.....	12
1.5 Report Structure .....	13
2. Literature review .....	15
2.1 Traditional and active methods .....	15
2.1.1 Types of Traditional and Active Methods .....	20
2.1.2 Advantages and disadvantages of Traditional Learning Methods.....	25
2.2 Innovative methods .....	30
2.2.1 Principles of Innovative Learning Methods.....	31
2.2.3 Types of Innovative Learning Methods.....	32
3. Research Methodology.....	39
3.1 Methodology Selection.....	39
3.2 Research questions .....	40
3.3 Research Methods .....	40
3.4 Ethical and Advisory Guidelines.....	43
3.5 Quality.....	43
4. Combined delivery mode .....	45
4.1 Method .....	45
4.2 Participants .....	46

4.2.1 Teacher .....	46
4.2.2 Students .....	48
4.3 Materials .....	50
4.3.1 Media sources .....	50
4.3.2 Skype for Business .....	51
4.3.3 Assessment process .....	54
- Willingness survey model .....	55
- Teacher survey model .....	57
- Interviews model .....	59
4.4 Procedure .....	61
4.5 Results .....	63
4.5.1 Willingness survey results .....	63
4.5.2 Teacher Survey results .....	65
4.5.3 Interviews results .....	66
4.6 Discussions and recommendations .....	71
4.7 Conclusions .....	74
5. References .....	76



## List of Figures

Figure 1. Percentage of people 25-29 years who finished the degree .....	16
Figure 2. Flow of information in Traditional Methods .....	17
Figure 3. Comparison the percentage of answers correct between Active and Traditional Methods. ....	19
Figure 4. Flow of information in Innovative Methods.....	30
Figure 5. Types of students in the Combined Mode. ....	48
Figure 6. Components of Skype for Business. ....	53
Figure 7. Student Willingness Survey Model.....	55
Figure 8. Teacher Survey Model.....	57
Figure 9. Interview Guide Model.....	60

## List of Tables

Table 1. Research Main Challenges .....	12
Table 2. Advantages and disadvantages of Traditional Methods. ....	26
Table 3. Advantages and disadvantages of Active Methods.....	29

## 1. Introduction

### 1.1 Background

The development of new technologies, especially Internet, which has highly increased the speed during last decade, turned them into a vital factor in the daily life of the citizens (Martin-Laborda, 2005).

In this way, children of today grow up having information and communication technologies (ICTs) as essential and natural parts of their daily life. As they grow, they are expected to become active and self-directed members in their own local communities and also in the information society at large. Technology creates versatile possibilities for the acquisition and creation of information, for self-expression, and for communication and interaction with other people locally, nationally, and worldwide. Active participation in the information society presumes novel knowledge, skills, and work approaches from children and teachers alike (Kankaanranta, 2005).

The rapid development of technology has challenged also learning environments to adopt ICT to support learning and teaching and in guiding children to become its diversified users (Baker, 1999; Bergman, 1999; Kankaanranta, 2002). But this challenge does not consist just in changing from the paper and pen to the computer and printer, but in the way that these technologies will be used (Martin-Laborda, 2005). The challenge is not to bring traditional courses to multimedia format, but be willing to adopt new perspectives in the conception of teaching-learning and the development of knowledge and skills (Cabero, 2003).

Despite these challenges, new technologies could provide education with the following advantages and facilities (Martin-Laborda, 2005; Cabero, 2003):

- Create more flexibility in the learning.
- Eliminate space-temporal barriers between teacher and students.
- Increase the communication opportunities.

Innovative methods to improve the learning

- Facilitate the permanent formation.
- Offer new possibilities to the orientation and tutoring of students.
- Encourage the independent self-learning and the collaborative learning in group.
- Enhance the interactive environment.
- Increase the sources of information.
- Languages convergence.

Other remarkable issue is the teacher`s role. Harasim et al. (1995) support that with the use of new technologies in education the teacher has two important tasks:

- On the one hand, develop a technical role that ensures that students understand how the multimedia tools work to have access to information and have the chance to benefit of new technologies advantages.
- On the other hand, the academic role of providing the students with the content of the course, following their progress and tutoring the students to solve doubts.

Thus, this master thesis has resulted from our desire of contributing to the research of how the new technologies affect education, their facilities and main barriers that the students face with these innovative learning methods, which are more and more influenced by the new technologies.

## **1.2 Scope of work**

Before going in depth with the thesis, it is essential to establish boundaries of the research, in other words, define the research scope. Due to the vast amount of information about learning, having an adequate project scope will facilitate our work saving time and focusing on the sources that really could have an important impact in our thesis.

The scope of this thesis is to study the evolution of the learning from the traditional to innovative methods, and the impact of these innovative methods on the educational environment. Due to the several kinds of innovative methods and the impossibility of analyzing the repercussion of all of them, the thesis is focused in one determined type: Combined mode. With the combined mode students can follow the class in two different ways; attending to the class or watching the class on-line from their places. In other words this method combines traditional lecture with online lecture.

To collect information regarding combined mode experiences, surveys and interviews were conducted with teachers and students in order to understand the experiences and barriers that they have found and their willingness to use this education in distance.

Finally, when the surveys and interviews are performed, all the data obtained must be analyzed to establish the corresponding results. Based on these results, we can decide if the introduction of education in distance has been successful and helpful for students, and the possible improvements necessary to solve the main barriers that the students have found during the online lectures.

### 1.3 Objectives

This master thesis pursues to achieve the following five objectives:

1. Conduct a comprehensive literature review to analyze and understand the traditional and active methods of learning, their different types, advantages and disadvantages of each one.
2. Conduct a comprehensive literature review about innovative methods.
3. Conduct a comprehensive empirical investigation performing the combined mode in one course of the university and analyze the willingness,

## Innovative methods to improve the learning

predisposition, motivation and possible barriers that students and teacher have found.

4. Identify, analyze and discuss the impact of combined mode in the education through the results collected in the surveys and interviews.
5. Recommend possible improvements and changes on the combined mode performance.

### 1.4 Challenges

During the development of the thesis, we have found some difficulties and challenges of methodological and human nature that we show in the next table:

Challenge type	
Limiting the scope	<ul style="list-style-type: none"><li>- Due to the vast amount of information about learning, select those articles suitable with our literature review.</li><li>- Select one of the innovative methods to implement in one university course.</li></ul>
Recruiting people to make the surveys	<ul style="list-style-type: none"><li>- Interviewer did not have previous experience on interviewing.</li><li>- Distribution and collection of the answers of a reasonable amount of surveys</li><li>- Difficulties to find students who followed the class online willing to be interviewed.</li><li>- Convince students that the interviews answers will remain in private and will not affect their academic results.</li></ul>
Data analysis	<ul style="list-style-type: none"><li>- Manage three different channels of information.</li><li>- Apply help to translate surveys written in Norwegian.</li><li>- Vast amount of information to process.</li><li>- Group the different students' answers in a objective way.</li><li>- Analyze individually those results that differ between students significantly.</li></ul>

**Table 1. Research Main Challenges**

## 1.5 Report Structure

This report is structured in five chapters that respond to the investigation's objectives as follows:

- Chapter one is the Introduction in itself, where we introduce the background of the research, the scope, objectives and challenges of the study and one explanation of how the research is organized.
  
- Chapter two corresponds to the Literature Review. It is divided in two parts; the first one describes the traditional and active methods, their characteristics, advantages and disadvantages. The second part develops innovative methods and their types, new methods where the multimedia perform an indispensable paper.
  
- Chapter three develops the Research Methodology, research methods that we have use to collect valued and reliable data, and those ethical guidelines considered.
  
- Chapter four develops the Combined delivery mode performed in this experimental researching. Within this chapter we describe the participants involved in the study, the media sources and software needed and the assessment process. Once the procedure is explained, we will present the results obtained through the surveys and interviews that will be analyzed to value the impact of combined mode and suggest possible proposals to improve these methods. Finally we present the conclusion of the thesis.
  
- Chapter five presents the References; in other words the sources of information and documents from which we have collected the information.

Innovative methods to improve the learning



## 2. Literature review

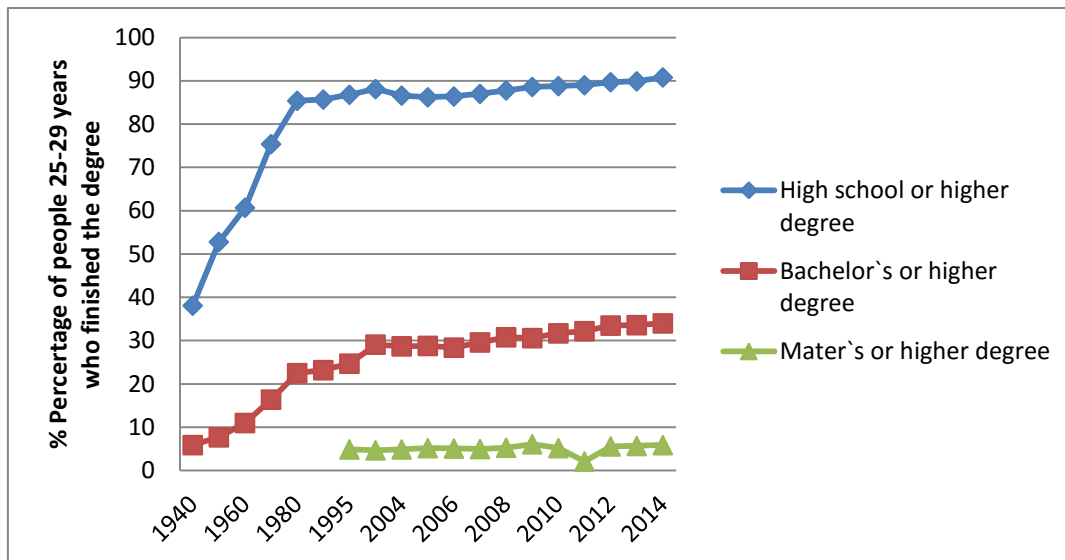
In this second chapter, focused on the literature review, we have analyzed the educational learning methods. It is divided in two different sections: the first part develops the traditional and active methods in which the information flows directly from the teacher to the students; and in the second part we have analyzed the innovative methods in which the multimedia plays an important role.

### 2.1 Traditional and active methods

The social and economic developments combined with the technological advances during the last decades have also been reflected in the educational area. Over the years, the number of people with access to educational studies has risen, allowing more people to have educational qualifications (Ghislandi & Raffaghelli, 2015).

Through the *Figure 1* elaborated with the data obtained from the National Center for Education Statistics 2014, we could analyze the percentage of persons between 25-29 years old with selected levels of educational attainment over the last 70 years. The graphic reflects that over the years the amount of people with academic qualifications and higher level of culture have increased considerably. This clear evidence is even more significant if we pay attention to the amount of people who finished high school and got a bachelor degree, whose percentages have increased 38.1 to 90, 8 % and 5.9 to 34 % between 1940 and 2014 respectively.

## Innovative methods to improve the learning



**Figure 1. Percentage of people 25-29 years who finished the degree.** \*(Graphic elaborated by the SOURCE: U.S. Department of Commerce, Census Bureau, *U.S. Census of Population: 1960*, Vol. 1, Part 1; J.K. Folger and C.B. Nam, *Education of the American Population* (1960 Census Monograph); *Current Population Reports*, Series P-20, various years; and Current Population Survey (CPS), March 1970 through March 2014.)

But not only the amount of people with studies has changed, the trend of learning methodologies is also developing continuously. In the past students were used to sit down and listen; however nowadays they want to explore, and they are able to make it due to the technological advances (Klopfer et al., 2009; Middendorf & Kalish, 1995).

According to the traditional methods of teaching, the teacher was the only sender of information. The educational material was the message that the teacher provided, and the students were only the receivers of the information. The unique delivery mediums were chalk and talk method and overhead projector transparencies, which made the students to assume a purely passive role and whose concentration decrease in a few minutes (Jackson et al., 2012).

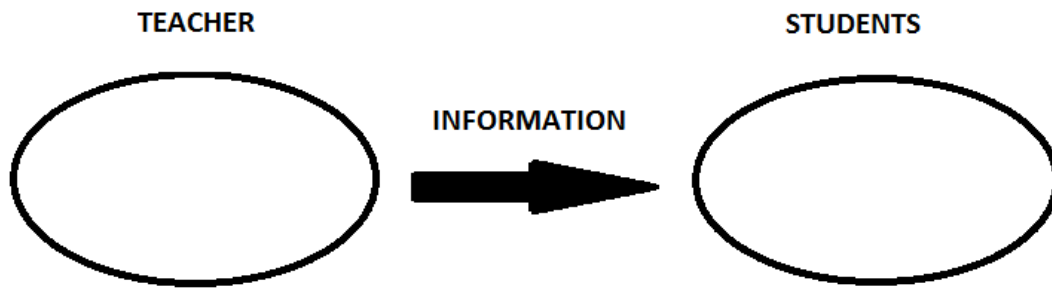


Figure 2. Flow of information in Traditional Methods

Thus, traditional oral lectures present some limitations such as there is only one way flow of information which produce insufficient interaction with the students, teachers often continuously talk for hours without knowing students response and feedback. Moreover the material presented is only based on lecturer notes and text book without the possibility to access to other ways of information to go in depth. This traditional method also emphasizes more theory and memorization than understanding the practical and real life situations (Damodharan & Rengarajan, 2007).

Thus, there is an evolution and adaptation in the teaching methodology from traditional methods characterized for its unidirectional flow of information to active methods where students acquired more prominence and are more engaged and active during the lecture. The concept of this active learning includes a range of activities that share the common element of —involving students in doing things and thinking about the things they are doing|| (Bonwell & Eison, 1991).

In this way, active learning instructional strategies can be created and used to engage students in thinking critically or creatively, speaking with a partner, in a small group, or with the entire class, expressing ideas through writing, exploring personal attitudes and values, giving and receiving feedback, and reflecting upon the learning. (Eison, 2010).

Innovative methods to improve the learning

- **Comparison between traditional and active methods.**

We can find many studies and researches comparing both methods. For instance, (Sokolve, 1998). This study intended to demonstrate that with the implementation of active learning methods students could achieve better grades. A clear example of that was developed in the University of Maryland, Baltimore County, where a study compared student performance on identical exam questions given to students in the traditional lecture and active learning of one course. In this experiment, there were two different groups:

- Group A or active learning group, where the teacher has the on-sight classroom role as observer and instructional consultant. The instructor was providing advice on implementing constructive ideas, cooperative learning and issue-oriented science teaching approaches that he has extensive prior experience with.
- Group B: the content of the course was taught using the traditional lecture approach.

During the course, both groups of students took the same evaluations in which students of active group answered correctly more multiple choice questions than the students who attended to traditional lecture. This fact demonstrated that students of active learning could understand easier and better the content of the course and acquired more knowledge.

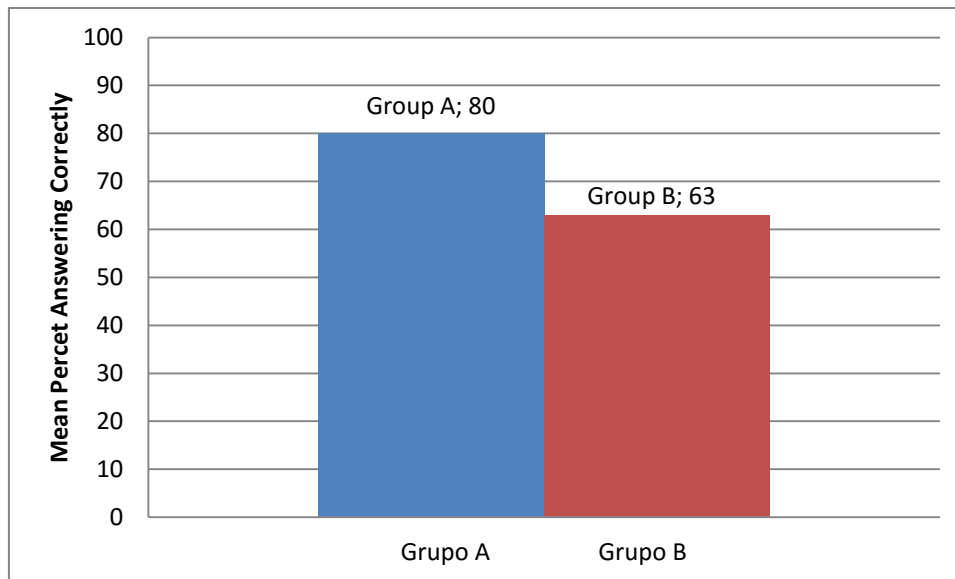


Figure 3. Comparison the percentage of answers correct between Active and Traditional Methods.

It is demonstrated that traditional methods of teaching are falling short in engaging students at higher levels of learning (Jackson et al., 2012). To adequately prepare students for a practice, active methods of teaching, learning and assessment are required to enable students to make a better connection between theory and practice (Prince, 2004; Wren, 2009). Educational studies and students' feedback indicated that students were engaged in a higher level of learning and understanding of engineering principles with these active methods.

Thus, the traditional methods do not motivate the students. They complete the courses with only a limited understanding of concepts and have limited opportunities to integrate them in real situations. Their attention is more focused into passing the exam than into understanding the real content of the course. That fact shows the need to modify the traditional style of lecturing and transition to a more balanced format of teaching that involves using practical projects to engage the students (Jackson et al., 2012).

In this way, in the last decades the trends to use the active methodologies as active methods have increased. With the increase of the globalization, educators are required to have the ability to adapt to technological changes and meet the new needs to solve complex problems. To address this challenge, active methods of teaching and

Innovative methods to improve the learning

learning are required with a particular emphasis on making the connection between theory and practical application that helps the students to understand the content of the course. With the use of these active methods, students are required to evaluate project scenarios with a diverse range of external and internal variables that require both technical and non-technical skills during the solution process. So, the use of active methods improves the understating of basic concepts, encourages deep and creative learning, and develops teamwork and communication skills (Jackson et al., 2012).

We can conclude this section with a Confucius' famous quote which supports that active methods present more advantages than traditional ones: "I see and I forget, I hear and I remember, I do and I understand" that highlight the importance to practice one activity to understand it properly.

### 2.1.1 Types of Traditional and Active Methods

After introducing and explaining the evolution of traditional and active methods, we are going to establish a classification of the main types of each one. To carry out this classification, we have analyzed the results of several articles taken from the data base, allocating the different methods within traditional or active methods depending on their characteristics and how the information flows between teachers and students.

#### - Traditional methods:

##### 1- Traditional lecture

Traditional lecture is an oral presentation carried out to present information or teach people about a particular subject. According to Edward et al. (2001) lecturing is the main teaching method used in the universities. In this way, the lecture is seen as a simply form of information transfer (Dolnicar, 2005), where the teacher will stand at the front of the room and recite relevant information about lecture's content to their students to convey critical information, history, background, theories and equations.

Last years with the development of innovative methods, lectures have been much criticized as a teaching method due to their low level of students` engagement encouraging intellectual passivity (Black, 2005; Kozma et al., 1978).

### **2- Guest Class**

Guest class enhances students` learning experience by providing current and relevant examples of practical applications they are learning in a particular subject. In this kind of classes, guest lecturers develop an active role sending the information to a large group of learners following the next objectives (Rowland & Algie, 2007):

- Explain to the students some of the problems their company was faced with.
- Seek student input into the ways for overcoming problems
- Reveal the strategies chosen by the company.

Guest classes are performed by prestigious professors, important managers or people who have been awarded with a recognized prize. In this way, students feel admiration for these people and intensify their attention trying to catch some ideas that help them to achieve a similar position in the future.

### **- Active methods:**

#### **1- Design projects**

In Design projects method, the course is structured such that part of the lessons are used to cover basic concepts and design principles, but most of the time is spent discussing and working on the projects individually or in small groups. These projects are designed to lead students through some content of the course, and make the connection between theory and practical concepts (Jackson et al., 2012; Jackson et al. ,2015).

Innovative methods to improve the learning

Design projects go beyond, generating student interest. Well-designed projects encourage active inquiry and higher-level thinking (Thomas, 1998). A design project is an instructional model that involves students in investigations of compelling problems that culminate in authentic products. Students' abilities to acquire new understanding are enhanced when they are "connected to meaningful problem-solving activities, and when students are helped to understand why, when, and how those facts and skills are relevant" (Bransford et al., 1999).

Projects grow out of challenging questions that cannot be answered by rote learning. Projects put students in an active role such as: problem solver, decision maker, investigator, or documentarian.

In addition, the central activities of a project involve inquiry and the construction of new knowledge by the student (Thomas, 2000). Students have a choice when it comes to designing their project, which allows them to pursue their interests and engage their curiosity. In the course of answering their own questions, students may investigate topics not identified by the teacher as learning goals.

## **2- Problem Based Learning**

The Problem Based Learning (PBL) develops self-education learner, awakens their curiosity, creativity and critical thinking while allowing the integration of theory with practice, their ability to find information, their interest for study and capacity to self-assess the learning (Ram et al., 2007).

This method has its first applications in the Faculty of Medicine at McMaster University (Canada) in the seventies and Dr. Howard Barrows was the one who first applied (Haslett, 1969). In this way, Dr. Howard in his method Problem Based Learning defended the idea that before students acquire certain knowledge, they are offered a problem through which they discover which new concepts they need to know to solve it.



PBL is oriented to achieve an active participation, where the student observe, study and discuss about the problem posed. The procedure is simple, in the first step the teacher presents the problems with which students are going to work. After that, students have to analyze and study the problem to identify the learning needs that they have to acquire to solve it. The necessary information is sought and eventually returns to the problem. This dynamic encourages critical thinking and the development of problem-solving skills while the students learn the theoretical basis of the subject (Labrador & Andreu, 2008).

### **3- Case Studies**

The case study method is one of the techniques that promote learning by discovery (Bruner, 1960). This learning encourages students to ask questions and to formulate their own answers and to deduce principles from practical examples or experiences, especially if it comes to problem-cases. The use of the case study method as a pedagogical medium helps students, both individually and in groups to learn better because they accept more responsibility in the discussion and approach the reality of their professional future, which implies that it is an active method that requires constant student participation (Prince & Felder, 2006).

This type of teaching-learning fosters curiosity and develops skills that facilitate the study over a lifetime, in addition to allowing students feel an active part of this process. Both students and instructors can significantly improve their management skills and broaden skills through the study and discussion of real situations due to the fact that this methodology develops the capabilities of logical reasoning and organization, information retrieval, analysis and evaluation data, development of useful conclusions, communication skills, etc (Labrador & Andreu, 2008).

The case method dates back to 1870 when Christopher Laudell introduced it in the School of Law at Harvard University as a strategy for training professionals. Since this moment its use has extended to several disciplines (Labrador, 2000).

## Innovative methods to improve the learning

In this way, this method is a tool which brings to the classroom a real problem, and students and teachers should examine the situation of the problem and develop, through the discussion that is generated, knowledge and skills, attitudes and values according with the specific objectives of the session and general course. In short, it is to offer cases that pose current situations that bring students to their future profession.

The description of the case must be clear, easy to read and with proper terminology. In some cases, it is advisable to add at the end basic questions to help focusing its analysis.

We can distinguish three types of case studies (Labrador & Andreu, 2008):

### 1) The problem cases or cases-decision

It is the most common type. This is the description of a problem situation on which it is necessary to make a decision. The situation is interrupted just before making a decision but include all the data required for analysis.

### 2) Cases-evaluation

These cases get practice in analysis or evaluation of situations, without having to take decisions and make recommendations for action. In this group we could include events or environmental accidents where it is necessary to assess the impact and scope.

### 3) Cases-illustration.

This is a situation that goes beyond making decisions. A real problem and the solution adopted in response to context are analyzed; allowing the group to learn about how a particular organization or professional has made a successful decision.

## **4- Trips**

Trips reinforce the main concepts and principles explained in class through exposure to practical applications. These field trips provide familiarization with equipment, processes, production management and problem solving in real life conditions. (Paez & Rubio, 2015).

### 5- Oral presentation

Oral presentation is a method in which students have to research about one topic and give a short presentation (about 10-15 minutes) to the class. The main objective of this method is to encourage students to research information to develop a project properly (Labrador & Andreu, 2008).

The instructor will generate a list of topic from which the students have to choose one; although there is also the possibility to propose a topic that the instructor could approve.

Thus, students are expected to investigate the underlying purpose of the topic, not just to summarize; explaining the meaning of the topic and its connection with the course content. Moreover the students should provide a handout to supplement their explanations. At the end of the presentation, the instructor and the rest of the students can ask to the presenter if something is not clear enough or they have any doubt. On the other hand, there is also the possibility that the students do a survey to ensure that they have paid attention.

### 2.1.2 Advantages and disadvantages of Traditional Learning Methods

Once we have defined the different types of Traditional Learning Methods, it could be useful to analyze the advantages and disadvantages of each type to establish which methods are more appropriate in each situation.

METHODOLOGY	ADVANTAGES	ADVANTAGES
<b>TRADITIONAL METHODS</b>		
1. Traditional lecture  (Ni, 2013; Neuhausser, 2010)	The lecture can be followed by high amount of students.  Allow interpersonal contacts between students and teachers.	No active Involvement of the students. Students are "sentenced to passivity".  Lack of attention.

## Innovative methods to improve the learning

	<p>Teacher can concise and accentuate the most important parts of the lesson.</p> <p>Gives the instructor the chance to be exposed to students' unpublished or not readily available material.</p> <p>Allows the instructor to precisely determine the aims, content, organization, pace and direction of a presentation.</p> <p>Can complement and clarify text material.</p>	<p>Lack of motivation</p> <p>Lack of long-term knowledge assimilation.</p> <p>Encourages one-way communication; therefore, the lecturer must make a conscious effort to become aware of student problems and student understanding of content without verbal feedback.</p> <p>Requires a considerable amount of unguided student time outside of the classroom to enable understanding and long-term retention of content.</p> <p>Requires the instructor to have or to learn effective writing and speaking skills.</p>
<p>2. Guest class (Rowland &amp; Algie, 2007)</p>	<p>Big groups could attend to a master class.</p> <p>Students pay an extra-attention and try to catch many ideas that they could use in their future.</p> <p>Past experiences of these celebrities could inspire students or encourage them to make some decisions.</p> <p>It requires little material to make it.</p>	<p>Limited intervention of the students in the discussion.</p> <p>The expositor has to be respected and admired by the students.</p> <p>The topic of the master class should encourage students.</p>

**Table 2. Advantages and disadvantages of Traditional Methods.**

METHODOLOGY	ADVANTAGES	DISADVANTAGES
<b>ACTIVE METHODS</b>		
1. Design Projects (Gadelana, 2002)	<p>Students develop autonomous behavior.</p> <p>Allow to work in a cooperative way.</p> <p>Improve the connection between theory and practice.</p> <p>Encourage students to design and resolve a real problem.</p>	<p>Be aware of the different level of students.</p> <p>Considerer and assess the different opinions within a project group.</p> <p>Select projects according to the content of the course.</p> <p>High amount of meetings teacher-students depending on the difficult of the project.</p> <p>Put too much pressure on students.</p>
2. Problem Based Learning (Labrador & Andreu, 2008; Schmidt, 1983)	<p>Foment the identification and understanding of the concepts and not only the memorization.</p> <p>Each team detects its own learning needs.</p> <p>Emphasize in a self-directed learning that will be necessary in the professional development.</p> <p>Facilitate the interdisciplinarity and integration of knowledge.</p>	<p>Possibility of wrong understanding of the problem.</p> <p>Select problems appropriately according to the content of the course.</p> <p>Student's frustration of not understanding the problem.</p> <p>The teacher has to guide and encourage the students properly.</p>
3. Case studies (Hernández et al., 1991; Yadav et al., 2007)	<p>Establish the connection between theory and practice.</p> <p>Foster critical assessment.</p> <p>Facilitate the understanding of the reasons why people had to act in a determinate way.</p>	<p>Ensure that all the students participate in the discussion and express their own ideas.</p> <p>Achieve or write a real case to analyze that students can use to understand a precise concept.</p> <p>Administrare the time of</p>

## Innovative methods to improve the learning

	<p>Allow to understand the different positions in a conflict or problem.</p> <p>Students acquire new experiences that allow them deal with similar situations and problems in the future.</p>	<p>discussion to not lose the attention of the group.</p>
<p>4. Trips (Greene et al., 2014)</p>	<p>Reinforce teacher instruction and help students understand the topic better.</p> <p>Students who go on Educational trips find that they want to learn more about the subjects on which the trip focused.</p> <p>Students retain information for longer periods.</p> <p>Students are energized by the excitement and anticipation of leaving the school environment.</p> <p>Develop critical thinking.</p> <p>Increase historical empathy and tolerance.</p>	<p>Spend time in the journey according to the distance of the trip.</p> <p>Ensure that the trip will be useful and interesting to the students.</p> <p>Encourage all the students to attend to the trip.</p> <p>Economic costs</p>
<p>5. Oral presentation (Haber, 2008; Haber, 2010)</p>	<p>Students train their critical thinking and on how to give constructive feedback.</p> <p>Students learn to think by themselves. The instructor would moderate, fill in omissions or correct errors.</p> <p>Each student would have the</p>	<p>The exposition could take too much time.</p> <p>Students should have communications skills to express their ideas/concepts/reasons properly.</p> <p>Shy students could feel</p>

	<p>benefit of the entire class' feedback and expertise, not only that of the instructor.</p> <p>Hearing others' reports would make the class more interesting than receiving feedback and a grade from the instructor alone.</p> <p>Students practicing oral presentations to a classroom would gain excellent preparation and skills for their future professional job.</p> <p>Knowing that one is due to give a public presentation would increase the student likelihood of coming prepared.</p>	<p>embarrassment and pressure of the rest of the students and the instructor "stage fright".</p> <p>The teacher needs to find enough exposition's topics to all the groups suitable to the content of the course.</p> <p>Each group/student should adapt the duration of the exposition to the requirements that the teacher has expressed before.</p>
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**Table 3. Advantages and disadvantages of Active Methods.**

## 2.2 Innovative methods

Apart from the traditional and active methods described before we are going to talk about the innovative methodology, resulting from the development of the technological resources. This multimedia development has contributed to each time more people have the possibility to access multimedia learning using innovative methods. Innovative methods use text, images, audio, video, animation to provide the information. Thus, with the multimedia learning, the process of learning is more interactive and students' engagement is higher. There is not just one way flow of information between teacher and students; in this case, the process is a mix between the student, teacher and multimedia resources (Damodharan & Rengarajan, 2007).

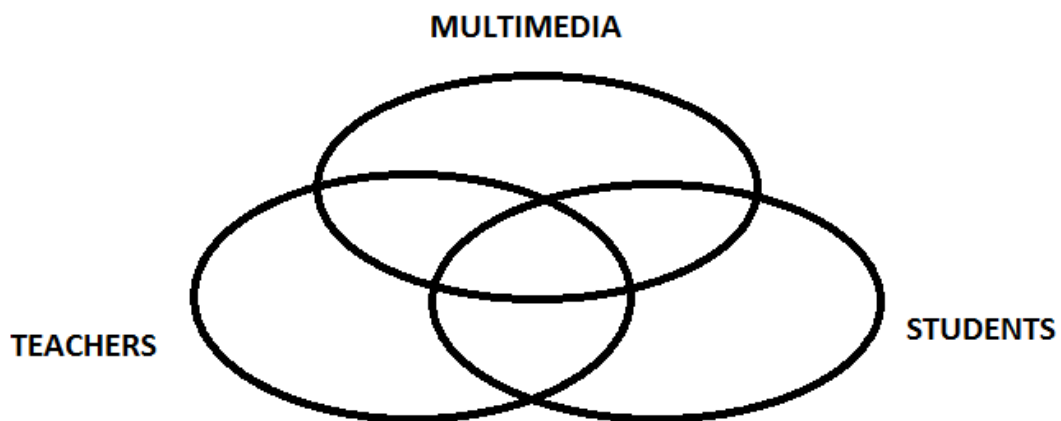


Figure 4. Flow of information in Innovative Methods.

The evolution of educational methodology progresses rapidly and together with the technological development. Nowadays, the researches about innovate learning are becoming more common and new techniques are tried and tested. Educators use these innovative methods to create an environment that will foster students' passion for learning.



### 2.2.1 Principles of Innovative Learning Methods

It is important that students learn appropriately the content of the course that they are taking; however it is also important to develop student`s ability to go beyond that, to have access to new sources of information, to question and apply learning in new and real situations. In this way, the principles that sustain the innovate learning are (Dumont et al., 2010):

1. **Learners have to be at the center of what happens in the classroom** with activities focused on their cognition and growth. They have to actively engage in learning in order to become self-regulated learners who are able to control their emotions and motivations during the study process, set goals, manage the study time properly and monitor their own learning process.
2. **Learning is a social practice and can't happen alone.** "By our nature we are social beings and we learn by interacting,"; "Co-operative group work, appropriately organized and structured, has demonstrated very clear benefits for achievement as well as for behavioral and affective outcomes. Cooperative methods work for all types of students because, done well, they push learners of all abilities." (Groff, 2013). We learn by pushing and pulling on concepts and experiences with other people, providing them different content and assimilating information that our mates share with us.
3. **Emotions are an integral part of learning.** Students understand ideas better when there's interplay between emotions, motivation and cognition, so positive beliefs about oneself are a core part of reaching a more profound understanding. The power of emotions and motivation in the classroom are well documented, but often overlooked because they are "soft." Still most teachers know that if a student is upset about something that happened at home or in school, he won't learn well. Similarly, keeping students motivated should be the starting point of learning. If students understand why it matters, learning becomes more important to them.
4. **Recognizing individual differences.** Students differ in many ways fundamental to learning: prior knowledge, ability, conceptions of learning, learning styles and strategies, interest, motivation, self-efficacy beliefs and emotion; they differ also in

Innovative methods to improve the learning

socio-environmental terms such as linguistic, cultural and social backgrounds. In addition, prior knowledge acquired – on which students vary substantially – is highly influential for how well each individual learns.

5. ***Stretching the students***. The teacher should identify individual differences and needs of their students. On this way, the educators should prevent both coasting and overloading them; encouraging students the need of experience both academic success and the challenge of discovery.
6. ***Assessment should be for learning, not of learning***. The learning environment needs to be very clear about what is expected, what learners are doing, and why. Otherwise, motivation decreases, students are less able to fit discrete activities into larger knowledge frameworks, and they are less likely to become self-regulated learners. Formative assessment should be substantial, regular and provide meaningful feedback; as well as feeding back to individual learners; this knowledge should be used constantly to shape direction and practice in the learning environment.
7. ***Learning needs to be connected across disciplines*** establishing horizontal links between the different areas of knowledge. Understanding the connections of subjects and ideas is essential for the ability to transfer skills and adapt in the real world. “The whole is greater than the sum of its parts” - Aristotle.

### 2.2.3 Types of Innovative Learning Methods

Below this overview of the currently innovative methods, its development and its principles, we are going to focus in which are the new future trends in this field. The amount of new innovative methods are increasing and expanding on several fields like business, social, economical sector, free time, educational discipline... In this section we are going to go in depth with the educational discipline, analyzing the current and future trends:

### **1) The Flipped Classroom**

The need to improve and stir up the educational methods has produced the rise and develops of new techniques such as The Flipped Classroom. This model inverts traditional teaching methods, delivering instruction online outside of class and moving “homework” into the classroom (Strayer, 2007).

In 2007, Jonathan Bergmann and Aaron Sams, two chemistry teachers at Woodland Park High School in Woodland, noticed that students often missed some lectures and discovered a software to record their lectures presentations. They recorded and posted their live lectures online for students who missed the class. The result was remarkable, and the online lectures started to spread, getting the attention of other teachers and educative centers about this new method. On this way, teachers began to use online videos and video podcasts to teach students outside class, reserving class time for collaborative work and concept mastery exercises (Bergmann & Sams, 2008).

Nowadays, many schools and universities have adopted the flipped classroom model. Here, we are going to analyze Clintondale High School (Detroit), which has employed this model with high rates of success. In that case, in order to implement the flipped classroom model the teacher created or delivered three videos each week and the students watched them (around 5 to 7 minute each one) at home or in the school if they did not have Internet access. This fact allows to have enough time during the class time to do labs or interactive activities to illustrate concepts explained in the videos (Fritz, 2013).

The beneficial results shown in the center are evident (Knewton, 2011; Strayer, 2007):

- Students receive instant feedback: Teachers have more time to help students and explain difficult concepts.
- Students do not feel frustrated: Before using this model, many students would not complete homework if they got frustrated with it; but working on problems in class minimizes this problem.

## Innovative methods to improve the learning

- Teachers can understand which concepts are more difficult to students: After each lesson, students write the questions that they have, and the teacher analyze the students` feedback individually to revisit concepts that students do not understand.
- Teachers support students in class explaining concepts that students haven't understood and doing exercises to reinforce and help to understand better the content of the course.

Clintondale High School carried out an analysis in two courses before and after the implementation of this model and the results were significant. The rate of failed students before the flip was above 50% in English and 44% in math; however after the implementation these rates descended considerably to 19% and 13% respectively.

### **2) Voice Threads**

VoiceThread is a revolutionary online tool that runs inside your web browser and lets to create multimedia albums in order to insert documents (PDF, Word, Excel, and PowerPoint), images and video with the added value that the visitor can post comments through a microphone; video through Webcams; or text via keyboard. There is also the possibility of drawing with a pen on slides and videos paused (Chicioreanu, 2010).

Thus, with Voice Thread the instructor can ask their students to do all kinds of multimedia presentations with high quality. One of the main advantages of this method is that students can post entries that could be added in a specific part of the presentation/video.

The conversations in Voice Threads are not live, but take place whenever it is convenient for the people to participate. They are also secure, with simple controls teacher dictates who can participate and what they can do. Educators use Voice Thread for many reasons, for extending and documenting classroom conversations, online tutoring, virtual classes, professional development training... (Khairnar, 2015)

The process of creating a presentation is simple and methodic and can be detailed in three phases (Diego, 2010):

- Upload from, where we decide which content we want to upload (documents in PDF, Word, Excel, Powerpoint, images, audio, video...) from My Computer, Media sources (like my Flickr, Facebook...) or URL.
- Comment, which help to understand the content. To comment, we have to choose the archive in which we want to add a comment. There are several ways to make it; with a video, recording an audio, typing with the keyboard or uploading the document where we have written the commentary.
- Share and save.

### **3) Kahoot**

Kahoot is an online platform used at the outset of each lecture as an interactive way to revise and summarize important concepts and definitions explained in the previous lectures. In this way, the instructor creates quizzes or surveys with multiple choice questions before the beginning of the class that will be projected onto the screen. The teacher provides the students the Kahoot's code, and they join registering with a nickname in their own device – whether that is a smartphone, iPad, laptop, or desktop does not matter, as long as they have a browser and good internet connection. (Hussein, 2015; Ortega, 2015).

Students have to answer the questions correctly and faster than the other students to add the maximum amount of points. The different questions can contain videos, images and diagrams that students should analyze and interpret before choosing one of the answers that the teacher proposes on the screen. Furthermore, the teacher can use different timer and points settings or multiple correct answers.

After each question, the screen shows how the classification is in that moment, depending on the number of correct answers and the speed to answer them. The winner will be the student who has more points accumulated after the last question.

Innovative methods to improve the learning

Nowadays, its use is increasing due to the big capability of engagement. Kahoot has achieved that in just a few minutes all the students are focused in the class revising the content of the previous lectures instead of being wasting their time talking with their mates. Other advantages of Kahoot are that players do not need to make a player account previously because it is a one-click gameplay and it is free to create and play.

#### **4) Screencast**

Screencast is a digital recording of computer screen output, also known as a *video screen capture*, often containing audio narration. The term *screencast* compares with the related term *screenshot*; whereas screenshot generates a single picture of a computer screen, a screencast is essentially a movie of the changes over time that a user sees on a computer screen, enhanced with audio narration. Screencast can be used for describing a step-by-step process, explaining a particular concept, or presenting a PowerPoint presentation with narration and multimedia elements. Thus, this method can be used in any class as a part of real-time instruction or as the lesson itself as in the flipped teaching model (Winterbottom, 2007).

With this method, instructors can use screencast videos to deliver their lectures, assigning them as homework. Then, in class students can ask questions as they work through problems that they normally would have done at home without teacher help (Khairnar, 2015).

So creating an educational screencast is a powerful, highly effective, and affordable learning tool that can facilitate learning across the curriculum area. It is a useful resource to create educative videos about how to make a step by step process to build something, resolve an exercise or solve any problem. On the other hand, in the educational area to prepare a screencast helps the students to prepare themselves in an easier and more comfortable way to the exam. They do not need to stay just copying the process of the blackboard during the class without understand the process; and they could pay attention to the explanation of the instructor. In addition

the possibility to resort to the screencast if there are any doubts will help the teacher to decrease the number of tutorial classes or Skype calls, saving time.

### **5) Blogging**

Blogging is a public post. Blogging for study sessions is to be practiced. Students can post case studies in a class blog and the teacher analyze, evaluate the content of these case studies and create the material according to their course (Khairnar, 2015).

On the other hand, blogging helps you to reflect. At the end of the lecture or presentation, teachers usually think back on what has happened in their classroom, and often wonder what they could have done better. Blogging can help with this process, enabling teachers to keep an ongoing personal record of their planning, actions, decisions, through processes, successes and failures, and the issues and problems that they have to deal with (Khairnar, 2015).

According to Daniel Chandler's quote: "When we write, we invest a part of ourselves into the medium", the act of composing and recomposing ideas can enable abstract thoughts to become more concrete. On this way, your ideas are expressed and captured on the screen in front of you, and they can be stored, retrieved and reconstructed as your ideas become clearer. You do not need to publish them; you can keep them in private. So, blog can act as a mirror to show you what you are thinking, and sometimes we do not really know what we are thinking until we actually write it down in a physical format.

### **6) Distance education**

Distance education or distance learning is the education of students who are not physically present at a school, including online broadcasting of the lectures and videos that the course's instructor prepares to supplement classroom (Brecht, 2012).

## Innovative methods to improve the learning

Education in distance could be developed into two modes of delivery: synchronous learning and asynchronous learning:

On the one hand, synchronous learning, all participants are connecting to the broadcasting of the lecture at the same time. In this regard, it resembles traditional classroom teaching methods despite the participants being located remotely. With this option, students have the opportunity to follow the lecture live online without the need to move to the university.

On the other hand, in asynchronous learning, participants access course materials flexibly on their own schedules. The videos have the same content and subject rigor as the classroom lectures, labs, homework, and exams, but are portable and can be studied when a student wants and at the student's individual learning pace. The lecture style is slower and more step-by-step than in classroom lectures (Brencht, 2012).

In this way, proponents of online learning have seen that it can be effective in potentially eliminating barriers while providing increased convenience, flexibility, currency of material, customized learning, and feedback over a traditional face-to-face experience (Hackbarth, 1996; Harasim, 1990; Kiser, 1999; Matthews, 1999; Swan et al., 2000).

The technological advances have increased the educational independency and even allowing the students to learn without attending to class and making their own schedules of learning. In this way, distance education is not a utopia and it is perceived as one of the best options to expand educational coverage at the higher level of education (Quesada, 2006).



### **3. Research Methodology**

This chapter presents a description of the methodology, methods, ethical guidelines and quality criteria we followed throughout this study. We provide detailed explanation of why we chose a specific methodology and methods. Furthermore, we present the tactics we followed to ensure the quality of work, along with the factors that limited the study.

#### **3.1 Methodology Selection**

Methodology is thus a strategy of enquiry that guides a set of procedures (Denzin and Lincoln, 1994; Creswell, 2013). The general research area of this investigation is innovative methods. These innovative methods constitute our main area of interest and our emphasis is to explore their impact in education learning compared with traditional lectures.

We consider it is important to understand the needs and the facilities that innovative learning methods present. Having into account that technology is currently spread in many different fields, it is interesting to see how this phenomenon behaves in educational environment. We used phenomenology methodology to see if the results that we would obtain verify that innovative methods are useful to our students.

The explored phenomenon of this study is the facilitation of innovative methods in project management learning and engagement of students. We explored this phenomenon by collecting, analyzing and understanding the perception and experiences of students and teachers about this new methodology.

Innovative methods to improve the learning

### 3.2 Research questions

Once we had identified the methodology, we developed a series of research questions that encircle the phenomenon we wanted to explore. The following questions served as guidance to the research and help us to remain focused on the scope of work:

1. How do the students perceive the learning and engagement through innovative methods?
2. What are the main barriers that this method could have for students?
3. What is the willingness of using innovative methods for teachers and students?

### 3.3 Research Methods

When we talk about research methods, it refers to techniques used to acquire and analyze data to create knowledge (Petty et al., 2012). In our case data collection was performed through different kinds of surveys conducted to students and teachers, and individual interviews.

Before going in depth into research methods, we want to clarify that thesis research contains two different phases. The first part is, gather all the information needed in order to get the theoretical background. The second one is the interview and survey part, in order to collect the useful data to answer the research questions.

Although the main researching part that will help us to analyze and verify the educational distance development is the interview part, the interviewer need to theoretical background knowledge in order to face properly the interview and collect useful information.

Learning literature is varied and wide, so before starting the theoretical part it is important to have clear which are the boundaries and scope of the thesis. After this delimitation, the research about the traditional, active and innovative methods of

learning will be done taking articles and papers of the database. To find useful and suitable information about the topic, first I chose different keywords which could provide me with articles related to the traditional methods, the educational evolution, active methods, and innovative methods. To cope with the huge amount of articles available about these topics, I read the abstract, introduction and conclusion of the articles. This fact helps to decrease the number of articles to analyze and rule out articles whose content were not related to our interest. After this selection, each one of the selected articles was analyzed trying to collect useful information to the theoretical part.

Once the theoretical part was finished, we continued with the experimental phase. In the process of collecting data, two main research designs can be chosen. On one side we have the quantitative research, where the data can just be evaluated in one objective way. To carry out this way of collecting data, the questions of the survey should be objective, the answers must be closed being the best way a punctuation test. Moreover, the researcher cannot have influence in the survey and his/her opinion will not be reflected.

The other side of the research methods is the qualitative research, based on the interpretation and so, the subjectivism, the opinion and the point of view. This kind of research can be done through interviews or surveys based in open questions where the interviewer can deepen more in some aspects. That fact allows finding easily the information that the researcher is looking for. Once the researcher has collected the information through the qualitative method the interpretation depends of his/her experience and point of view (Silverman, 2006).

Within this experimental phase, we can distinguish two different parts, the surveys and the interviews. First, two different surveys were conducted with students and teachers respectively to evaluate their opinion, experience and unwillingness to use or teach using combined mode. The surveys have two different uses: collect information and observe where we should deepen with the interviews.

## Innovative methods to improve the learning

After an exhaustive analysis of the surveys, we precise which information is needed to be asked in the interviews. Within the interview we can differ two parts:

- A structured interview, this interview characterized by the fixed sequence of questions which are easy to quantify – this means it is easy to test for reliability (Turner, 2010; McLeod, 2014). The questions were written first and not improvised for not skipping any important question and get all the necessary data.
- A non- structured part, we the interviewer have the opportunity to have a conversation about some specific parts and giving the chance to the student to add more information.

After the conclusion of each lecture, the teacher offered the possibility to the online students to carry out an interview of his/her experience following the class in distance. The difficulties for getting students to face-to-face interviews reduce the final number of interviewed to four students who followed the class in distance through Skype for Business whose names will remain anonymous.

In order to prepare the interviews, the objectives need to fit inside the interview plan, and also they have to be coherent with the global objectives of the survey (Flick, 2004). Thus, we elaborated a list of the objectives and information we needed to collect. The next step was to organize these questions in different sections according with the typology and information sought. In the Chapter 4 we will develop how the different surveys were structured.

Once we gather all the survey's information, the processing of the data should be the most objective possible. Within the open questions, those answers with the same meaning will be grouped and established as a conclusions of the surveys. On the other hand, those answers that differ among students will be studied deeply and proposed as possible questions and objectives of the interviews.

After the surveys, interviews were done according with the main list of questions elaborated previously and those aspects from the surveys that we want to clarify. The final results of all of them were analyzed as a whole, establishing the conclusions that we will compare with the initial plans and suppositions. This analysis is one of the most relevant parts of the research because it will let us verify or deny what the combined method impact is, and propose several modifications to improve this method.

#### 3.4 Ethical and Advisory Guidelines

During the interview and survey process it was necessary to keep in mind some ethical considerations and some confidentiality must be kept during the interviews. Although the information that the students offered haven't affected their marks, they felt more secure and confident if the information had a private character. In this way the information collected is personal and will remain in private. The interviews were done by students who followed the class in distance, so I really have to appreciate all the efforts done in order to help me with my research and for sharing with me all the information needed to evaluate the impact of this innovative method. At the beginning of each interview we applied permission to record the conversation with audio recording software and take notes with the objective of remembering the maximum number of details and considerer all the information when we establish the final conclusions.

#### 3.5 Quality

After the surveys and the interviews were conducted, it was time to organize and group the information. Apart from the particular interviews, we can distinguish 2 different surveys conducted to different integrants of the class:

- Survey to assess the motivation for using this new method.
- Survey to teachers to know their opinion, experience, possible barriers of learning and predisposition to use education in distance.

## Innovative methods to improve the learning

Each type of survey is focused on a specific group trying to collect precise information. Once we have organized the surveys, it is time to check the value the data of the surveys and analyze the interviews.

While I was reading the surveys and interviews obtained, the issues that all the students/teachers had in common were taken as objective data and conclusions and the differences were also considered and studied as important.

## 4. Combined delivery mode

### 4.1 Method

The method which supports our experimental case is combined mode. This method is a combination of traditional lecture with a synchronic online lecture that goes to beyond hybrid methods currently used in most of educational centers.

The use of hybrid method has become more popular in the last decade facilitating the learning of students. Within hybrid method we can differentiate two parts: traditional lecture and e-learning/online asynchronous classroom (Black, 2002):

- Traditional class: where the learning is conducted in a synchronous environment, meaning that the students must be in the same place at the same time in order to learn
- E-learning/online asynchronous classroom: which is an online computer based educational tool or system that enables to learn anywhere and at any time. E-learning offers the ability to share material in all kinds of formats such as videos, slideshows, word documents and PDFs. Moreover students could have the opportunity to watch recorded classes and establish communication with professors via chat. E-learning provides the learners with the ability to fit learning around their lifestyles, effectively allowing even the busiest person to further a career and gain new qualifications.

However, the implementation of combine mode, apart from hybrid method, allows the students to watch the classes online and live from other places, in other words faculty and students are physically separated. This fact presents some advantages to the asynchronous online lecture, allowing students to get an immediate feedback and taking part in the different activities than those the teacher proposes during the development of the class.

Innovative methods to improve the learning

The following study has been developed in the TPK4115 “Project planning and control” course delivered by the University NTNU (Trondheim, Norway). The program consists on one course carried out by combined mode, where through a sophisticated system of video the lectures are streamed live enabling students to follow the class live online or to attend to the class face-to-face.

In this way, students can follow the classes from different allocations, alone or with other students. To each one of these groups, we assessed the perceptions and experiences of students and teachers facing this educational model through surveys and interviews.

## 4.2 Participants

Education in distance is a new term that breaks down the barriers of the space allowing to the students to attend to the lectures without the need to move from their places. In our project, we can distinguish different participants whose roles and manner to follow the class differ considerably. There is a teacher, who is the responsible for the class and the sender of information; and three different groups of students who are going to follow the class from different places and using different technological media as we are going to explain below.

### 4.2.1 Teacher

The teacher is the responsible for transferring the knowledge and content of the course to their students. In this way his/ her role and actuation are essential and some aspects should be considered to ensure the learning of the students (Dabaj et al., 2004; Quiroz, 2010):

1. Teacher should determine how to organize and present the content in a clearly way that facilitates the comprehension of the students.



2. Teacher should consider the differences between traditional education and education in distance, acting in accordance with the need of each group.
3. Teacher promotes learner autonomy and is aware of individual differences.
4. Teacher uses relevant and current information to transmit knowledge. So the instructor should constantly upgrade the curriculum and provides concrete up-to-date examples.
5. Teacher gives importance to the thoughts of students and promotes students' research, evaluation, discussion, and reporting.
6. Teacher is aware of individual student differences when designing course materials
7. Teacher knows student prerequisite skills and knowledge, and uses this foundation to build new knowledge.
8. Teacher initiates student-teacher interaction, and he should have the communication and technological skills to implement distance education effectively.
9. Teacher constructs student-centered learning with opportunities for interaction.
10. Teacher collaborates with student in self-development and responsibility.
11. Teacher provides materials, and guidance for collaborative learning, interactive discussion groups, individual learning, and research.
12. Teacher provides prompt and accurate feedback to students to facilitate learning.

#### 4.2.2 Students

Focusing on the several types of users who could develop their learning process using combined mode, we have experimented with three groups of students allocated in different places and whose roles, characteristics and ways to follow the course differ considerably between each others:

- Group 1: Students who attend to the class in person. (Traditional lecture)
- Group 2: Students who follow the lecture alone with their computers by themselves from their places.
- Group 3: Group of students who follow together the lecture projected onto the screen in other allocation.

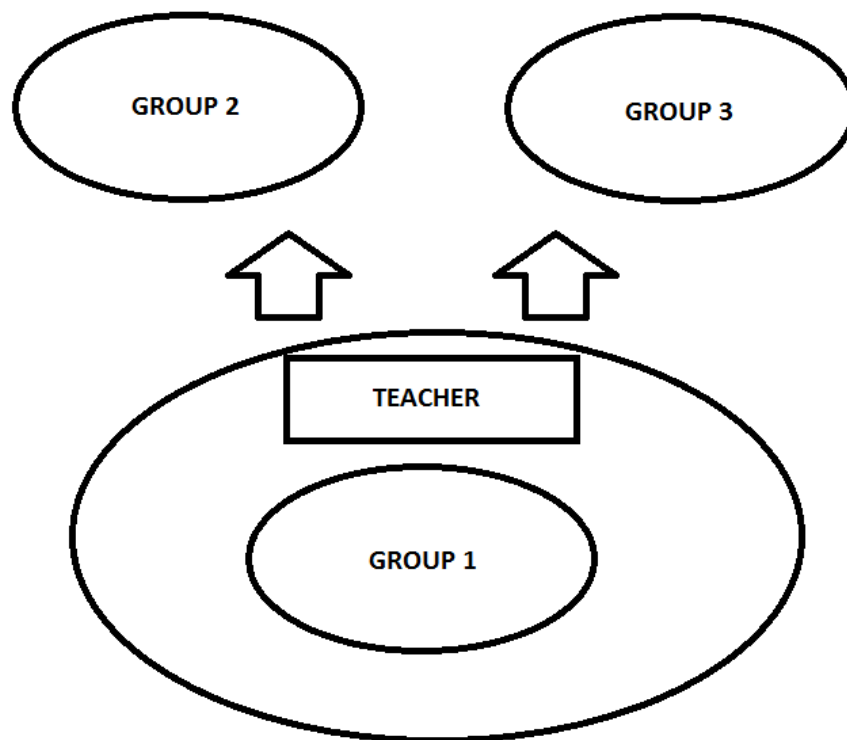


Figure 5. Types of students in the Combined Mode.

These three groups will allow us to have a complete panorama about the different ways to attend to the class in our experiment. Then we will be able to compare between the three situations and to see if there exists some correlation. Due to the objective of this experiment, having the different groups is the best way to see how innovative methods could be introduced in class. Within these three groups we will pay special interest into the students who followed the classes in distance (groups 2 and 3), because students from group 1 followed the class in the traditional way, the same as they were used to.

#### *4.2.2.1 Students who attend to the class in person.*

This first group includes all the students who decided to move to the class VG1 in Lerkendal and Valgrinda Campus to attend to the class face-to-face with the teacher and other students. To this kind of students the lecture was carried out in a traditional way: the teacher is the sender of information; students listen the explanation and interact with the rest of their mates consulting doubts or debating about the different projects explained by teacher.

#### *4.2.2.2 Students who follow the lecture from their places.*

This second group includes all the students who preferred not to attend to class and follow the lecture using a computer or tablet from their houses. In this way, before to the beginning of the lecture the teacher send a link by mail, and students only need to open it and establish connection with the class through Skype for Business System. That fact allows that the student could watch the lecture class in live at the same time they listened the explanation of the teacher.

During the class the teacher chooses the content that students watch in their screen, existing the possibility to select between PowerPoint slides, videos, blackboard content or just the teacher presenting and talking about the lecture.

Innovative methods to improve the learning

#### ***4.2.2.3 Group of students who follow together the lecture projected in a screen from Stripa.***

This third group includes all these students who met with other classmates in a different campus where the teacher is giving the lecture. In our project, the students met in Stripa and followed the class projected in a big screen with other fellow students without the need of moving to Lekendar Valgrida Campus.

### **4.3 Materials**

The next step of this chapter is to explain the media sources necessary to broadcast the class and software used in the combined mode to develop the education in distance. Finally, we have explained the different surveys and interviews carried out in the assessment process in order to value the impact of combine mode in Project planning and control subject.

#### **4.3.1 Media sources**

Before going into detail about the software tool needed to broadcast the online lecture, we consider that it is important briefly enumerate all the media sources that we are going to use. In this way, the University needed to make an important investment to acquire several products and licenses that we enumerate below:

- Skype for Business system
- Camera
- Screens
- Projector
- Blackboard
- Internet connection
- Computers or tablets (students who don't attend to class and follow their lecture by themselves)

### 4.3.2 Skype for Business

Once we have enumerated the media sources necessities to perform lectures in distance, we want to analyze Skype for Business software. Within the several options to carry out distance educational methodologies, we have used Skype for business to perform the experimental case of the thesis. Skype for Business is a powerful tool that let you add up to 250 people to online meetings, high-quality communications, gives you enterprise-grade security, allows you to manage employee accounts, and is integrated into your Office apps.

Throughout this section we present and analyze in depth Skype for Business. To facilitate the understanding, we have supported our explanation in the *Figure 6*. which shows us and clarifies us the different components of Skype for Business and their connections. To carry out this section, I needed to meet with a technical expert in Skype for Business who explained its operation and provided me with technical knowledge.

#### *Components of Skype for Business*

Skype for Business is composed by different components interconnected to each other that we are going to present below:

- 1- **Video Gateway** is a tool which allows to connect and tune the images and video recorded by the camera allocated in the back of the class with the audio emitted by the teacher during the explanation of the lecture.
- 2- **Video TeleConferencing system** is sophisticated tool that allows the teacher to determinate which types of video/images are broadcasted. Skype for Business provides two options/windows of emission depending on if the students should focus on the teacher explanation or on the Power Point slides/ video that the teacher is using to his/her explanation:

## Innovative methods to improve the learning

- 2.1- In this option the camera focuses the teacher. In this way, the students will see the teacher in their computer screens, his/her moves, and all the notes that he writes in the blackboard.
  
- 2.2- With this option the students watch in their screens the different PowerPoint presentations or videos that the teacher has chosen to explain the lecture at the same time that students have the possibility to listen the teacher explanation live.
  
- 3- **Front-End Server:** Once the video, images and audio are being recorded it is essential to establish a properly connection between the teacher and the students who want to follow the class with their computers in distance. In this way, Skype for Business server allows the interconnection and transfer of information through images, documents, or live videos between different participants allocated in separate places.
  
- 4- **Students** who follow the class by themselves with their mobiles phones or Pcs.
  
- 5- **Group of students** who meet in another class to follow the class projected in a big screen in other campus.

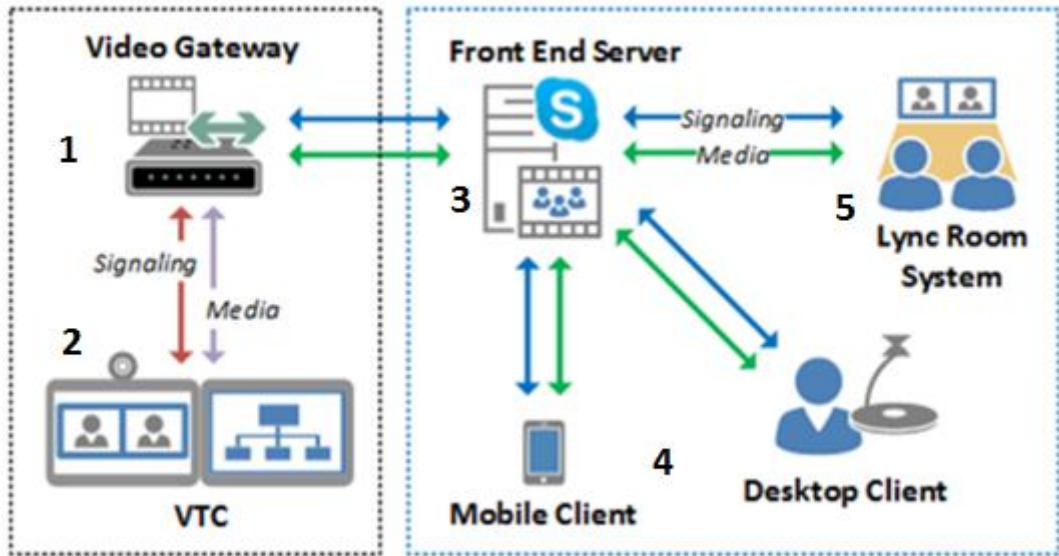


Figure 6. Components of Skype for Business.

Innovative methods to improve the learning

### **4.3.3 Assessment process**

In the assessment process we explain the different methods of evaluation performed by students and teachers to collect the information. After the exposition of each type of survey and interview, we have considered important to include a guideline of the different parts and questions that have been conducted in each survey/interview that help the reader to clarify which information we wanted to achieve.

#### **4.3.3.1 Willingness survey**

The first type of survey is the student willingness survey. This was conducted in order to understand their motivation, expectative and receptiveness to use education in distance. This survey is designed to uncover potential barriers and enablers of using this kind of synchronized delivery.

The survey is organized in three different kinds of questions: yes/no questions, ranking questions and finally open questions. In this way, the survey addresses questions about if the students have past experiences attending to on-line lectures, technical problems, engaging during the class, the possibility to ask questions in live, the quality of image and sound to follow the presentation correctly and their motivation to use this new methodology.

On the other hand, in the open questions the students have the possibility to express his/her preferences to attending a lecture in the classroom or watching the lecture on-line and why. Once they have pointed their choice, the survey focus in finding out the main benefits and drawbacks of on-line lectures, as well as the conditions that must be fulfilled for those students to rather attend lectures on-line.

Finally, the survey offers the possibility to add any relevant comment and the contact details if he/she is willing to be interviewed in connection with this survey.



- Willingness survey model

**STUDENTS WILLINGNESS SURVEY MODEL**

**PART 1 YES/ NO QUESTIONS**

- 1- Have you attended to on-line lectures previously?

**PART 2 RANKING QUESTIONS**

- 2- If your answer to the previous question was YES please tell us how would you rate your experience with attending live lecture on-line using the following statements (*1 strongly disagree and 6 strongly agree*):

- I did not experience any technical problems
- I felt myself engaged in the lecture as if I was physically present
- I was able to ask questions, and get responses
- It was easy to see and follow the presentation / the blackboard
- It was exciting to try something different

**PART 3 OPEN QUESTIONS**

- 3- If you are able to choose between attending a lecture in the classroom and attending the lecture on-line what would be your first choice?
- Classroom
  - Online
- 4- What is the main reason of your choice?
- 5- From your perspective as student, what are the benefits / drawbacks of attending the live lectures on-line rather than the classroom?
- 6- In your view, what are the conditions that must be fulfilled in order that you would rather attend lectures on-line?

**PART 4 ADDITIONAL COMENTARIES AVAILABILITY TO PERFORM AND INTERVIEW**

- 7- Anything else you wish to add? Please provide your contact details if you are willing to be interviewed in connection with this survey.

Figure 7. Student Willingness Survey Model.

#### *4.3.3.2 Teachers survey*

This survey is addressed to teachers in order to investigate about their willingness to change from the traditional lectures to a combined mode where students could attend to traditional lectures in the classroom or watching them live on-line. This new combine delivery mode presents some modifications in comparison with the traditional lectures: apart from the students who attend to the class in person the teacher should pay attention to students who follow the lecture in distance. This fact implies an extra difficult challenge: coordinate and manage different groups allocated in various places.

At the beginning of the survey, the teachers are asked about if they have past experiences using combined delivery mode and online classes, the amount of technical problems that they had, the level of engagement of the students with this methodology, how the communication was with the students online and if they feel excited to try this new methodology.

In the section of open questions, teachers expressed if they are willing to try delivering lectures in combined mode and which reasons support this decision. This survey also tries to find out from the perspective as a teacher, what are the benefits and the drawbacks of delivering lectures using combined mode, and which are the conditions that must be fulfilled to encourage teachers to deliver lectures using combined-mode.

As in the motivation lecture, this survey also includes a section where teachers could add comments or provide details if they want to be interviewed according with the questions of the survey.

- **Teacher survey model**

**TEACHER SURVEY MODEL**

**PART 1 YES/ NO QUESTIONS**

- 1- Have you delivered lectures using combined delivery mode (holding a live lecture in the classroom and broadcasting the lecture to on-line participants / learners?)

**PART 2 RANKING QUESTIONS**

- 2- If your answer to the previous question was YES please tell us how would you rate your experience with delivering lecture in the combined mode (*1 strongly disagree and 6 strongly agree*):

- I experienced lots of technical problems that difficult the learning process
- I was able to engage the online students in the same way as students in class
- I was able to interact and communicate easily with on-line students in the same way as students in class
- It was exciting to try something different

**PART 3 OPEN QUESTIONS**

- 3- Are you willing to try delivering lectures with the combined mode?
- 4- What is the main reason for your choice in the previous question?
- 5- From your perspective as a teacher, what are the benefits / drawbacks of delivering lectures using combined mode?
- 6- In your view, what are the conditions that must be fulfilled in order that you would want to deliver lectures using combined-mode?

**PART 4 ADDITIONAL COMENTARIES AVAILABILITY TO PERFORM AND INTERVIEW**

- 7- Anything else you wish to add? Please provide your contact details if you are willing to be interviewed in connection with this survey.

Figure 8. Teacher Survey Model.

#### *4.3.3.3 Interviews*

According with the results obtained, we have considered that the possibility of interviewing some students who followed the class through the online way could provide us with a more complete view of the possible barriers, opinions, benefits and drawbacks of this new method.

To carry out this research, several students were interviewed during 45 minutes, providing us with their experiences and opinions about the different aspects that will be useful to establish the final conclusions.

This interview based in open questions was composed of four different parts. In the first section the instructor deals with questions about how online lectures have fulfilled different aspects as the quality of the image and sound, the quality of the different chats to ask questions to the teacher or share opinions with other students, the facilities of the interface, the latency of the streaming, the capacity that the students have to control what to watch in their screen in each moment, the duration of the class, how will be the possibility of recording the classes, the teacher's skills of giving the lessons with this combined mode, the opportunity of having more online courses.

The aim of the second part of the interview is to compare some aspects between following the class online or attending to the class: Level of learning and knowledge acquired, the engagement of the online courses comparing with attending to the class, level of attention, difficulties that they had in the online lecture, which types of tools (PowerPoint, blackboard, teacher explanation) were easier and more difficult to follow and which types of courses are more suitable with this methodology.

In the third section of the interview, students were asked about the reasons of attending to online lectures.

Finally, in the last part of the interview students gave their opinion about their preferences and there is the possibility to add more additional commentaries and suggestions.

- **Interviews model**

**INTERVIEW GUIDE MODEL**

**COMBINED DELIVERY MODE**

These questions are asked to students who were not allocated in the classroom, and follow the lecture in distance through internet system application.

**PART 1 ASPECTS FULFILLED**

- How many lectures have you followed online?

**Accorded with your experience in the last online classes: how have on-line classes fulfilled these aspects?**

- 1- Broadcast the lecture with high quality of image and sound.
- 2- Enable the student to make questions in live.
- 3- Enable the student to chat with other students and share opinions.
- 4- How were the teacher skills and the organization/structure of the class?
- 5- Were there any to difficulties to use the interface and connect to the class?
- 6- Do you think the students have enough control to choose what to see in the screen: PowerPoint, blackboard, teacher explanation?
- 7- How was the synchronization? Did you receive the sound or images with latency?
- 8- How important is to have the chance to review the lesson more times?
- 9- Do you consider that online lectures should have the same duration as traditional lectures? Less or more?
- 10- Would you like to have more courses online? How many?
- 11- During the class did you only follow the class or were you also doing other things?

**PART 2 LEARNING**

**The aim of this second part of the interview is compare the following aspects between follow the class online or attend to the class:**

- 1- Learning. Knowledge acquired and understanding of the concepts.
- 2- How was your engagement in the online class comparing to attend to the class?
- 3- How were you level of attention?
- 4- What aspects were the most difficult in your online lecture?

- 5- What types of tools that the teacher used were easy to follow: PowerPoint, blackboard, teacher explanation? And which one was more difficult?
- 6- Do you think that combined method is suitable to all the courses? Which kind of courses could we develop with online class and which no?
- 7- Is online class more suitable to theoretical or practical/exercises class?

### **PART 3 REASONS TO FOLLOW THE CLASS IN DISTANCE**

- **How did you follow last lectures and to which group do you belong?**
  - 1- Students who follow their class by themselves from their places.
  - 2- Group of students who follow together the lecture projected in a screen in other allocation.
  
- 1- Which are the reasons that make you not attend class? Work? Incompatible schedule? Distance to the university?
- 2- If any reasons force you to choose a specific method, and you could choose, which methods do you prefer and why?
- 3- Why of the three methods do you think is less useful? Why?

### **PART 4 ADDITIONAL COMENTARIES OR SUGGESTIONS**

- Would you like to add any comment about online classes?

**Figure 9. Interview Guide Model.**

## 4.4 Procedure

In this section we explain the development of the research. To carry out the combine delivery mode, first it was necessary to take a course about how to use Skype for Business program. The technician explained us how Skype for Business works, its features, the different possibilities and menus. Finally we made a simulation class to try the different tools that Skype for Business contains.

In this way, the procedure to establish the connection and deliver the class online is very systematic. In the process to connection we can differentiate these two different parts that we present below:

- Process before the class
  - The teacher needs to create an account in Skype for Business (This step should be done only the first time ).
  - Log in with his/her nickname and password.
  - Create an online meeting.
  - Send the link of the meeting to the students, giving the chance to not attend to the class and follow it from their places.
  
- Process during the class.
  - Log in and open the link of the meeting that he/she created before the class.
  - Start the broadcasting of the video.
  - Students can connect to the server through the link that they received to see the class live.

After explaining the process of connection to broadcast the class, it is time to present how the process of data collecting has been carried out. First of all, we conducted the surveys. On the one hand, teacher surveys were distributed by my supervisor Hussein B. to several teachers via online. Furthermore, I was the responsible, to spread the

Innovative methods to improve the learning

willingness survey to the students. In both cases, the answers of each survey were stored individually and saved in our data base.

Once we had the final results of each type of survey, we started with the data analysis. I read and studied all the interviews, one by one, and grouped all the answers which try to express the same idea in objective and homogeneous affirmations. Thus, all the issues that majority of students had in common were taken as objective data and conclusions; and the issues with answers notably different were also studied and considered as possible questions to the interviews.

After the analysis of the surveys, the teacher offered to the online students the voluntary opportunity to be interviewed about their experience in the online lectures carried out with the combine delivery mode.

Finally, we conducted four interviews with students who followed one or some online classes. We made individual meetings in different places according to the student's time and disposition. Each interview lasted about 45 minutes and helped me to go in depth in some issues that were not clear enough in the surveys, or aspects that I could verify or deny with more precision and security.



## 4.5 Results

This chapter presents and analyzes the different data obtained in our research. The data has been obtained through different procedures surveys and personal interviews. Once we have obtained all the data, due to the fact that most of the questions of surveys and interviews are based on open questions, it is essential to organize and group the answers in a correct way to extract relevant conclusions.

In this way, to each kind of survey and interview we present their final results arranged in decreasing order of importance according with the analysis of the data.

### 4.5.1 Willingness survey results

	YES	NO
<b>Students who have attended on-line lectures previously</b>	<b>5</b>	<b>20</b>

<b>Manner to follow the class</b>	
Preference to attending a lecture in the classroom	<b>14</b>
Preference to on-line lecture	<b>11</b>

<b>Main reasons to choose attending lectures in the classroom</b>
More confident of learning better staying in contact with other students and the teacher
Being online causes to a decrease of concentration and attention
Meet students
Ask questions live and solve them in the blackboard

<b>Main reasons to choose on-line lectures</b>
Save time
Be more independent and the possibility to combine lectures with other activities/trips
Less distractions and loses of concentration interacting with other classmates
More facilities to get all the information that the teacher provides and record important classes to review the before the exam
Save Money

<b>From the student perspective: Benefits and Drawbacks of on-line lectures</b>
<b>On-line lectures benefits</b>
No need to move, increasing the comfort and allowing sick students to follow the class
Save time
Be more independent
Possibility to record the classes and review them

## Innovative methods to improve the learning

Less distractions caused by interactions with other classmates
Save Money
More students can follow the class
<b>On-line lectures drawbacks</b>
Students don't have the possibility to interaction with other classmates
Less concentration
Difficult to solve doubts
Lectures less inspiring
Harder and less motivated to be alone long time in front of the computer
Don't have the possibility to appreciate some details of the blackboard or gestures of the teacher
Possibility to miss the class if there is any technological problem
The need of advance media source

<b>Conditions which must be fulfilled to students rather attend to on-line lectures</b>
Dispose the adequate material to broadcast the class with high quality of image and sound : media sources, internet connection.
Create a chat to make questions live
Create a chat with other students to share the opinions
Good teacher skills, organization and structure of the class
High facilities to use the interface and connect to the class
Have the control to choose what to see in the screen: PowerPoint, blackboard, teacher explanation
Good synchronization. Very-low latency.
Possibility to review the lesson more times.
Short classes to keep high level of attention
Availability of more on-line courses

### 4.5.2 Teacher Survey results

	YES	NO
Teachers who have delivered classes using combined mode (holding a live lecture in the classroom and broadcasting the lecture to online students/learner))	4	8

	YES	NO
Amount of teachers willing to delivering lectures in the combined mode	8	4

Reasons to delivering classes in combined mode
Exciting to learn and try something different
Opportunity to reach more students and facilitate them the access to the lectures
The teacher should update to adapt to the new trends
Save time (Less particular tutorial meetings)
The lecture is going to be explained anyway. If the student only can follow the class in distance, combined mode will be useful to help the students without increasing the amount of work to the teacher.

Reasons to not delivering classes in combined mode
Only specifics courses/lectures could be delivered with this methodology
New methodologies like education in distance should be installed step by step and no directly
Combined mode is not seen as a future trend yet, not be able to use it correctly
Increase the work

From the teacher perspective: Benefits and Drawbacks of combined mode lectures
<b>Benefits of combined mode</b>
Reach that more students follow the class and easier access
Possibility to review the class after more times
Increase the flexibility
Improve and enrich the teaching
Decrease the noise of students who don't pay attention and just stay talking during the class
Help students to save time
<b>Drawbacks of combined mode</b>
Technical problems
Challenge to coordinate and manage big groups of people allocated in different places
Be more focused in coordinate that in the content of the lesson
Attend to one place and interact with other students is closer that they will do his/her future job
The need to establish connection online to the students each class
Increase the amount of work

<b>Conditions that must be fulfilled to teachers</b>
Easy access and good internet connection
High quality in image, sound during the broadcasting and appropriate internet blackboards
Introducing combined- mode step by step and getting used to use it.
Technical assistance to solve problems
Tutorship to familiarize students with the program and teach them how to use it.
Possibility to record the lesson
Possibility to chat students-teacher in live
Align this methodology with the goal and setting of the education
Good pedagogical planning

### 4.5.3 Interviews results

#### **Aspect s fulfilled**

- In general terms the quality of the image and sound is very good
- Facilities to ask questions live through chat teacher-students. Skype for business offers the possibility to ask questions in live. This fact enables students to feel more confident and to have the chance to be in contact with the teacher continuously to solve doubts.
- Students have the option to share information and opinions with other classmates. During the class, the teacher could propose different topics of discussion and debate that students should analyze and reflect on the possible resolutions. In this way, the student chat let students exchange their opinions and point of view with other online students in the same way as if they were attending to the class.
- Intuitive interface to establish connection with the class. The process to connect to the class
- Low latency. There were not any problems in the broadcast. The quality of the image and sound during all the online did not suffer any interruption. Moreover, the image and audio coincided during all the transmission.

**Aspects not achieved**

- Difficulties in changing the different windows: PowerPoint, blackboard and teacher explanation. One of the main difficulties of online lectures was to move through the different windows.
- Technical problems to connect to the interface. In some particular situations Skype for Business presented some problems to access to the online lecture due to a technical problem. Students needed to spend near to 20-30 minutes trying to connect and miss the first part of the class.
- Too much feedback noise of the students in punctual moments that deteriorate the quality of the sound, and make impossible to listen some content of the class.
- Difficulties to listen the questions that students who attend to the class do. Due to the fact that students who attend to the class do not have a microphone, when they ask questions online students can't listen the doubts, suggestions or contributions of their classmates.

**2º COMPARATION BETWEEN ONLINE CLASSES AND ATTENDING TO THE LECTURE**

- **Learning:**  
The quality of the technological media and the possibility of making questions live enable to understand the concepts and the acquisition of knowledge in the same way as attend to the class.
- **Engagement:**  
Very good. Students feel more confident typing the questions from their places than asking something in front of 150 students. That fact increases the amount of questions that each students make and decreases the doubts that maybe the student would not solved due to his/her shyness.
- **Level of attention:** Good. In general terms, the level of attention is quite similar to attend to class. In class the main distraction is to talk with the rest of your classmates and at home the student does not feel the pressure of the presence of the teacher and makes more breaks to look up in other websites.

- **Drawbacks of online lectures compared with attend to the class**

- Blackboard visualization: The zoom of the camera is not enough to appreciate some important details. In this way, the resolution and precision of the camera do not enable students to read an copy some content of the blackboard.
- It is more difficult to make notes. In some moments of the class, the camera could change its position and the student does not have the opportunity to change it again.
- Problems with the connectivity. Some students have had problems to connect to the class. They tried to connect several times and missed the first part of the class.

- **Tools to develop the class:**

- PowerPoint and teacher`s explanation: offer the same facilities and possibilities that attend to the class. The use of PowerPoint allows the teacher to support the content of the class with some slides.
- Blackboard: it is hard to follow the class when the teacher writes in the blackboard. The zoom of the camera is not enough to see some important details and students are continuously missing information.

- **Suitability of online courses:**

In spite of the fact that all the courses could be developed with combined method, it is more suitable with theoretical courses because the teacher supports in PowerPoint and teacher explanation, and the need to use the blackboard is low.

On the other hand, practical courses present some difficulties as: see the blackboard properly, pay attention to the questions chat constantly, and facilitate the discussions with other students about the topic that the teacher proposes.

### **3º REASONS TO FOLLOW THE ONLINE CLASSES**

Within all the facilities that combined mode offers, students highlight as the main reasons of following the classes online the distance from their places to the university and the time wasted to move to the university.

Students feel more comfortable and independent if they have the chance to choose from where they are going to follow the class. Moreover, the fact that students can have their courses in different campuses increases the importance to online courses. In this way students could follow the class from their places or other campus and avoid the need of moving.

On the other hand, students feel curiosity and interest about how the learning will be in the future, which encourages them to try these online courses.

### **4º PREFERENCES AND ADITIONAL COMMENTARIES**

- According the majority of students' opinions, the actual preference is to attend to the lecture face-to-face in the classroom. Students still consider technical problems the main drawback of online lectures. In spite of the fact that their experiences with online classes were successful, faced with an important lecture students feel more confident attending to lectures. A technical problem could make them miss a whole or some parts of the class, without the possibility of watching it again.
- However with some improvement like secure connectivity, better quality of the blackboard image and in punctual moments decreasing the feedback of the audio most of students would prefer to follow the class in distance. A high percentage support the combined mode as a successful tool which enables them to be more independent, ask questions in an easier way, save time and money and don't miss the class if the student is sick one day.
- According with students suggestions and more difficult barriers to follow online lectures, the improvements that we should keep in mind are:

## Innovative methods to improve the learning

- Ensure the connectivity to the interface. The main reason students mistrust in online class is the possibility that a technical problem happen and they do not have the possibility of connect to the class on time, missing some important concepts. Some of them insist in the need of a technical service which solves these kinds of problems.
- Improve the quality of the image when the camera focuses the blackboard. Students insist in the need of more zoom to appreciate some details. The size of the blackboard is too big, so the possibility of choosing which part to see in each moment would facilitate its vision to make notes.
- Nowadays students can access online courses through Skype for Business or Link. However when students connect to the class through link, they have found several difficulties to change the different windows depending on their computer`s operational system. Technical service should solve this problem to allow students to choose what to watch in their screens in each moment.
- Students also insist in the possibility of having the classes recorded and posted on itslearning to review them if there is any content not clear enough.
- In some punctual moments due to the students' noise feedback, the quality of the audio is worse, and online students can not listen some parts with the same precision.
- Encourage students to use more the student chat to share their opinion on some exercise resolution or study cases.
- Expand this combined mode to other courses. Students take some courses at the year, so to be more independent and have the possibility to follow the class from their places this methodology should be expanded to the rest of subjects.



## 4.6 Discussions and recommendations

In the following chapter we are going to assess the results presented previously. Firstly, we will analyze the results of the surveys that show the willingness of students and teachers to use combined mode. After this analysis, we will compare the conclusions collected through the interviews with the expectations established before to carry out this method.

Before going in depth with these comparison and analysis, we would like to affirm that the results are quite good. The level of implication in the answers of students and teachers was high providing us with value information.

The process of analysis and group the data was hard and took most of the time of the research. Due to the high percentage of open question and the different reasons and ways to communicate the same idea, we needed to make a previous lecture to conceive the diversity of answers. After that, we established an objective classification grouping those questions which expressed the same idea.

Although we would like to have the chance to interview more students who watched the class online, the fact that most of students followed the class attending to the lecture face-to-face and the unavailability of some of online students decreased the number of students interviewed. However, the interviews that we finally made were so extensive and answers fully coincided in the main points of interest.

### - **Analysis of the results**

As we have commented before, the results of the surveys are useful because they provide us with some conclusions about willingness of teachers and students to use it, past experiences that they have had with online classes, benefits and limitations that they hope to find in this combined method. On the other hand, the conclusions of these surveys will be useful as vehicle to formulate some of the questions of the interviews.

Based in the results of both surveys, we have discovered that in spite the fact that most of students have not tried online lectures before, they are willing to use it. In this way, students support that with the use of online lectures, the independence of students increases considerably giving the opportunity of combining the lectures with

Innovative methods to improve the learning

other kind of activities/trips and even enabling sick students do not miss the class. Other important factor is the reduction of time wasted in the movement from their places to the university, and the conformability of connecting to the class from anywhere even instantly.

However, we observed that more than the half of the students prefer attending to the lecture in the classroom than following it online. The main reasons that support that fact are:

- Students prefer to stay in contact with other students and teachers. They feel more confident in achieving a better learning if they have the chance to interact with other mates and teachers. Most of them also support the idea that staying in the class will facilitate the resolution of doubts instantaneously.
- The other main prejudice is the lack of trust in the technological media. Students insist that due to a technical failure, they could miss the class or if the quality of the video is not enough high they could not visualize some details of the blackboard.

Focusing now in teachers` opinions, they support that the use of combine mode, the course could reach more students and facilitate the access to the lectures. However, teachers specify some negative aspects that should be kept in mind. They consider that some courses are not suitable to develop with online tools. In addition, combined mode could involve an additional work for the teacher who needs to coordinate students situated in different locations and solve technical problems of connection at the same time that they perform the class.

Once we have analyzed the results of the surveys, it is time to perform the interviews. Apart from the questions previously established, we wanted to go in depth about some aspects collected in the surveys as:

- The quality of the video
- The connectivity and control of Skype for Business
- Learning

- Engagement
- The possibility to solve doubts
- The suitability of the courses
- Based in their new experience using the combined mode, which is their new preference now: attending to the class or following it online.

All the students interviewed support that the quality of the video was high during all the class. They could follow the teacher explanation in the same way as when they attend to the class. However, all students showed two requirements to improve:

- On the one hand, the zoom of the camera was not enough high to visualize some details of the blackboard, missing some details that could be useful for the resolutions of the exercises.
- On the other hand, due to that the fact that students of the class do not dispose of a microphone, it would be recommendable that the teacher types or repeats the questions made by the students of class, so that online students could not listen properly.

Focusing in the connectivity and control of Skype for Business, students expressed some troubles. The process to connection to the class presented some error, and in particular moments students missed the first minutes of the lecture. In addition they would like to have a more intuitive menu that allows change through the different windows easier.

In respect of the level of learning and the engagement, it was very high. Students verified that they could learn in the same way as attending to the lecture. On the other hand the engagement was even higher than attending to the lecture. Students support that the procedure to ask questions is better than to make it in class. They felt more confident by typing the question than asking it in the middle of the lecture with all their fellow mates paying attention to him/her. In this way, this fact contrasts with the result obtained from the willingness survey where some students thought that the solution of doubts might be worse with the online lectures.

## Innovative methods to improve the learning

Through the interviews, we also want to know the opinion of students about if combined mode is suitable for theoretical or practical lectures. The answer was almost unanimous, combined mode could be suitable for both types of methods, but it is necessary to make some improvement in zoom of the camera to develop properly a practical lecture in which the students could appreciate all the details necessary on the blackboard.

Finally, we wanted to make a valuation based in their experience in combined method. Most of students insist that combined mode is an useful method that complements the traditional lecture perfectly, but in order to increase the amount of students who watch the class online it is necessary to make some improvements. It is a powerful tool in which a technical improvement in the connectivity and zoom of the camera will facilitate the learning of lots of students in a near future.

### 4.7 Conclusions

The final step of our research is to analyze if our project has managed to solve the research questions satisfactorily and make a valuation of the final results.

Firstly, according to the level of learning and engagement of students who used combined mode, the results are very satisfactory. Due to the high quality of the video, correct operation of the question chat and the teacher skills to give the lecture, students confirm that the level of learning and understating is the same that of attending to the classroom face-to-face.

On the other hand, the results of the engagement were even more surprising. A high percentage of the learners affirm that they felt more engaged with online classes that attending to the class, supporting this fact with the facility to solve doubts. During their attendance to the classroom, students had doubts or troubles that they did not ask in that moment due to their fear of being the centre of attention of the entire

classroom. However, with the use of the chat students feel more comfortable to ask questions and solve them immediately, increasing their engagement capability.

The second research question approached the main barriers that students have found using the combined method. In spite of the fact that the successful rate of students were in favor of using combined method, throughout our research we have identified several barriers that difficult the learning of students. On the one side, in particular moments the process to connection to online lectures presented some errors. These problems needed to be solved because students could miss class and so decreasing their trust in using combined mode.

On the other side, students found problems with the blackboard visualization. In this way, if the course plans to go further the PowerPoint slides and oral explanation, the teacher needs the blackboard to carry out his/her explanation or resolution of exercises, some improvements must be made. The technical assistance should fix the camera, checking that the quality of the video when the camera is focused on the blackboard will make possible to visualize all of the details perfectly.

Finally, the last research question deals with the student and teacher willingness to use combined method. In both cases, their predisposition is high. While teachers consider that the use of combined mode will facilitate the students` access to the class reaching more students, students appreciate combined method as a tool to increase their independence. In this way, students dispose of both alternatives, attending to the class face-to-face or watching the lecture live online, between which they can chose depending on their interest in each situation.

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