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Re-Thinking Education:
The Self-Learning Technology Environment

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Abstract

Technology can provide different resources that improve the education system. It was recognized in earlier studies that education is looking for a change because of two main reason: one is economic and the other one is cultural. This study used a qualitative process research methodology in order to explore how technology can improve the education system. Consequently, the following research question is addressed: "How can we use technology in the education system?" With respect to this question, it is argued that technology can radically change the relationship between teachers and students and provide different teaching and learning opportunities. Therefore, literature and case study were put together into an inductive conceptual model that will design a new education model. This thesis contributes to literature on changes in education, in terms of organizing innovation and technology implementation. The results confirm literature and suggest that the technology in education has a big impact in the education system, only if teachers are able to organize the classroom and support strategies in order to help, guide and facilitate learning.

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ADHD	Attention Deficit Hyperactivity Disorder
ICT	Information and Communication Technology
KA	Khan Academy
CBL	Computer Based Learning
GDP	Gross Domestic Product
IT	Information Technology
IQ	Intelligence Quotient

1. Introduction

1.1 Summary

This study is focused on technology in the education system. Regarding this concept, the world is looking for a change in the education system, an innovation that could change the way the world learns. The education system all over the world came from the British empire and it was born to meet the need of the industrialism, Mitra (2013). Every student, in fact, must be able to read, write and do operation in their mind and, at the same time, to adapt himself to the working system all around the world. In the recent years, the education system is becoming a protracted process of university entrance and is dominating our view of intelligence. Students that are talented, brilliant and creative are not valued for their worth but they are often stigmatized, our education system is becoming outdated in the sense that due to the rapid technology evolution that the world is facing, the education system is the only one that is still not evolving. In particular, is not preparing the future generation to these changes.

The aim of the second chapter then, was to analyse the existing research and the literature about the technology in the current education system. In the literature there are two different ways of implementing the education system, on one side there are research about incremental innovation, this approach is more conservative and try to implement technology without effective changes in the education model. For example, computer inside the school are used only within a laboratory and are mainly used to write report, doing research on the internet or play some games. On the other side, researcher says that a disruptive innovation approach can lead to a new education model. In particular, the literature finds that in social system such as education the most important thing is develop a design that is well organized and where shared perspective is needed to ensure collective and internally consistent action. The introduction of ICT provides different learning opportunities and the need to design a new model of pedagogy that will promote an organic structuring of learning experiences, a communicative learning and the possibility to change the role of the teacher from group to individual learning.

Innovation in the education system need to redefine creativity and intelligence that in the recent years are losing their meaning, creativity should be seen as the ability to invent something that is useful and novel and intelligence must be seen as the ability to solve problems, to generate problem to solve, to offer product or service. From the current literature ICT can lead to improvement for both teaching and learning. ICT could help teachers to make the lesson more interesting because they can explain thing more clearly, it could be used in most curriculum subjects and the most important thing is that technology will encourage teachers to vary the organization of their lecture within the classroom. The literature concludes saying that technology has an impact in the education system, only if teachers are able to adapt to the interactivity and to change their pedagogy approach. Teachers needs to organize and support strategies in order to help, guide and facilitate learning.

To analyse the technology in education, chapter three described the methodology that was used to understand technology in education. In a qualitative approach, researchers tend to collect data in the site where participants experience the issue or the problem under observation. In this context, the researcher will have the possibility to join the system and interact with the problem face-to-face. One of the main instrument to obtain a consistent qualitative research is the case study. the role of case study method in research becomes more prominent when issues with regard to education (Gulsecen & Kubat, 2006). Even if a common criticism of case study method regards its dependency on a single case exploration making it difficult to reach a generalising conclusion (Tellis, 1997), this study decides to go through a qualitative analysis, in the specific, analysing the Khan Academy' case study.

In particular, in this chapter we have reported some existing study about Khan Academy. KA is an education website most known for its collection of videos, it offers exercises, instructional videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom. It provides a variety of materials in different subjects including maths, computer programming, science, history, economics and more. Salman Khan, founder of Khan Academy, created this website with the idea of supporting schools and children during the education process.

Schools utilize KA's resources in different ways, some schools believe that it must be used as an additional practice tool that intervene only for students who had fallen behind, others thought that KA must be used as an enrichment activity for advanced students and other as a tool for monitoring student's progress. In addition to that, the use of KA depends in every school from the different access to IT infrastructure and the levels of comfort of both teachers and students in the use of technology. The results of this analysis are very interesting, in fact, students level of engagement was higher for the majority of the classroom respect to the traditional approach. The interactivity through feedbacks, hints and access to videos help student that were struggling and at the same time give them the possibility to learn new things on themselves without the help of a teacher. Teachers also got advantages thanks to the KA experience, in fact, they increase their ability to monitor student in terms of knowledge and identifying students who are proficient and who are not. Teachers also report that the use of Khan Academy positively affect student learning and understanding of the material.

In the fourth chapter, that is the Empirical Analysis, this study presents a full analysis of the Khan Academy education model. Starting from the structure of the courses and analysing all the features that makes KA a different education system: interactivity, crowdsourcing, customization, availability, motivation. Before introducing this features above it was necessary to discuss the importance of Computer-Based Learning (CBL). CBL refers to the use of computer as the main instrument of the educational environment. This definition does not rely only to the learning through web browsing or gaming on computer, but refers to the use of computer in a classroom in a structured environment in which computer are used for teaching purposes. Among the advantages of CBL there is the ability to provide quantifiable and real-time feedback for users and it also give the possibility to educators to measure the progress of the classroom and of the single student. On the other

side, the sceptical argue that CBL is limited to specific subjects and is not as good as having a human teacher because computer can only answer in the way it has been programmed.

The courses are structured mainly with short instructional videos followed by exercises/activities and at the end of each topic a mastery challenge in order to collect data and information about every user's' ability. The interaction within the website is really simple for both students and teachers. Students in his/her profile have the possibility to look at his progress, discussion, project and feedback received by the community. Teachers can register their own class online and manage the learning of their children, teachers also must let their students know that they have a free tutor available inside and outside the classroom. The coach interface is divided in more section and they mainly give the possibility to the teachers to obtain all the necessary information about the children progress and activities.

The first characteristic of Khan Academy is the possibility to be free and available to everyone, everywhere the only limit is Internet connection. The customization of learning is one of the most important feature of Khan Academy, students can personalize their study based on their type of intelligence and on their speed of learning. For example, students watching video tutorial can pause and repeat all the time they need to understand deeply the concept, without disturbing the rest of the class or being embarrassed for asking a "stupid" question to the teacher. Another good quality of KA is the good design of the website that is really valuable, it is really intuitive and easy to use and this encourage the children learning. Khan Academy provide a motivator model, in fact, it gives the possibility to make several attempts at solving problem rather than giving the final solution. In this way, the model motivates the student to think about the problem, giving hints and video that explain the problem that is presented in the exercise.

A little exploratory questionnaire was made in order to evaluate the reaction of Khan Academy's users within computer-based learning environment. For this research is necessary to understand if the users are participating actively on the website and if they find this education system better than the traditional education model or not. The aim of the questionnaire was to understand if CBL is useful for all the subjects, if users interact with videos, hints, questions and the community, if is possible to study on your own and finally if this model could be implemented in education. This exploratory questionnaire provides very good results with a participation of 60 users from Khan Academy blogs and social network.

In the end of the fourth chapter, this research presents an inductive model, that represent a new system of education that is characterized by the findings of the literature and the Khan Academy's case study. The input that drives this conceptual model is the Information Technology, with its primary focuses on technologies such as Web-based learning, database, customization and interactivity. These inputs must be processed and collaborate together with the teaching and learning program, cultural change and the process of data mining, processing and reporting. This inductive model consider education as a self-learning environment in which, students can learn at their own pace during the day, inside or outside schools, that constantly give information about the student's activities to the teachers.

The evidence that result from this conceptual model led to a radical change in the education model in which the education can be shifted from a one-size-fits-all approach to a self-learning environment. The features that we have mentioned before like customization, transparency, interactivity, crowdsourcing and data mining become relevant in the creation of a new education system. The main differences between the traditional education system and this inductive model are in the different approach to the classroom. There is a new pedagogical role for the teachers because in a technology supported classroom, educators need to promote the self-management, rotation and foster multiple perspective. This new system must expand the role of educational system to maximize the human potential and serve the needs of the community in the future.

1.2 Research Problem

The education system in every country on Earth, at the moment, is reforming public education for two main reasons:

- Economic: in order to answer the following question "How do we educate our children to take their place in the economy of the 21st century?" given the fact that we cannot anticipate what the economy will look at the end of next weekend?
- Cultural: in order to answer to that question "How do we educate our children so they have a sense of cultural identity while being part of the process of Globalization?"

The problem is that the current education system is trying to meet the future by doing what they did in the past and by following this path they are "wasting" millions of kids who do not have any interest in going to school.

In the past, children that went to school believe in the fact that working hard and doing well at school, will send you to the university and then you would get a job. In the current generation is it obviously better having a degree but it is not a guarantee anymore of a good job. In particular, not if the road to the job marginalises what you think important about yourselves. The problem stands in the fact that current education system was designed, developed and structured in order to satisfy the need of the Industrialism and was conceived in the intellectual culture of the Enlightenment. Before that system there was not a system of public education, most of the lesson were private, but with that system public education was paid by taxation and it was compulsory to everyone and free at the point of delivery.

The education system was driven by an economic imperative of the time and by a cognitive model in which the real intelligence consists in the capacity for certain type of deductive reasoning and the knowledge of the classics called academic ability. If we think about the education system there is always a distinction between two types of people, academic or non-academic, smart people or non-smart people and the consequence of that is that many brilliant people think they are not because they have been judged against this particular view of the mind.

Education is modelled on the interest of the industrialisation and on the image of it. Schools are organized on factory lines, including ringing bells, separate facilities, specialised into separate subject and

children are educated by age group. This research wants to ask question like “why do we do that?” and “Is this the most important thing in education?”

There are kids that are much better than other kids of the same age in different disciplines or different times of the day or they can learn better in small group rather than larger and kid that prefer to study on their own. Traditional education believes in a growth that is standardized and conformed and we can see that every day in the increasing number of test and in the creation of a standard curriculum.

Robinson (2011) sustain that this model has caused chaos in many people’s lives, it has been great for some but most people have not. In fact, some children have been diagnosed with ADHD (Attention Deficit Hyperactivity Disorder). Today, we are living in the most intense stimulating period, in fact, people always interact with computer, mobile phone, advertising on television and probably this is one of the main reason why children find everyday lesson at school boring. Our children are living an education model that is “anaesthetic”, it means that the education system is shutting down most of their senses.

In the entire world, there is a huge percentage of dropout rate of high school. By the way, the dropout rate is just the tip of an iceberg. What it does not count are all the kids who are in school but being disengaged from it, who do not enjoy it, who do not get any real benefit from it. The main reason to that is that the education system it is all going in the wrong direction.

This research will show the possibility that we could go in another direction that is exactly the opposite. We need to create a model based on the “aesthetic experience” that is when all the senses are operating together. There is a study called divergent thinking and it is the ability to see lots of possible answers to a question, lots of different ways to interpret the question and think laterally, De Bono (2009). In the book “Break-Point and Beyond” 1500 people were tested on “divergent thinking” and the protocol of the test says that if people score above a certain level they were considered genius. It was a longitudinal study in which they tested the same children at the age of kindergarten and then again at the age of 8-10 and then at 13-15. So, on the first test kids the 98% of the kids were considered a genius and then as the children grow up the trend immediately decrease. This study demonstrates that every child has this capacity until they become educated. Children spent 10 years of their life at school being told that the answer to the problem is at the end of the book and you do not have to cheat or copy because that is cheating, outside school this characteristic is called Collaboration.

In order to solve this education problem there are 3 things that are necessary to be highlighted and that this study will try to explain:

- We need to think differently about the human capacity, we need to go over the distinction between academic or non-academic, abstract, theoretical;
- We need to recognize that the collaboration between students improve the learning experience;
- Third, it’s crucially important to think about our culture, the habits of our institutions and the habitats they occupy.

1.3 Research question

On the basis of what we read in the previous pages is necessary to answer a series of question "How can we change the education system? What is influencing the performance, whether good or bad? And can we introduce new technology in our education system in order to stimulate the creativity of our students?"

In order to answer this question, it is important to summarize some current literature on these topics. The current literature talks about creativity in education, most of the time children do not like what they are studying or they are not interested in it. Sometimes happen that these young children will be diagnosed with ADHD because they cannot reach specific results in test. Children do not like studying because they do not give importance to that, probably because they do not understand why they are studying it and why it is worth to study it. Human being are naturally different and diverse but every child has in common one thing: Curiosity. If you can stimulate the interest of children in a particular topic, they will learn without any further assistance, very often. Kids are naturally learners and we can prove this in everyday life by watching them using different kind of technology without anyone explain it.

The current literature also speak about technology in education, is it possible to implement technology in order to stimulate the creativity of children? There are different studies that prove that children can use computer and teach to their selves how to browse, how to play games and at the same time explain to people around how to use it.

Other lecture also talks about the possibility to change the organization model of education from the traditional model that is defined as "one-size-fits-all lectures" to a more interactive model where children learn at their own pace and the teacher only intervene on children that are struggling on specific topics.

During my thesis, I would like to provide an answer to this main research question:

- *How can we use technology in the education system?*

And then each of the following sub-questions:

- *Can we rethink our education system?*
- *What are the existing studies about changes in the current education system?*
- *Does technology stimulate creativity through education?*
- *How technology will improve the education system?*

1.4 Research Method

To study these research questions a method was chosen that basically consists out of three important parts. As a first step, a literature study on technology in education is executed. The objective of the literature study is to answer the question "What are the existing studies about changes in the current education system?" and to explore the main findings about technology and its implementation within schools. Literature explains that we need to support innovation in the traditional schooling, change the learning environment, rethink an educational model and how we plan education. The overall conclusion from the research literature is that ICT

is used effectively and has an impact on learning where teachers are able to appreciate that interactivity requires a new approach to pedagogy. Teachers need to employ proactive and responsive strategies in order to support, guide and facilitate learning. They need to monitor progress and maintain a focus on subject learning, by structuring activities carefully and providing focused tasks.

Second, a methodology chapter is needed in order to collect data and methods to identify the most efficient way to implement technology in education system. In this chapter, we decided to analyse this research through a qualitative approach and the Khan Academy case study. Case study have been increasingly used in education, in fact, schools of business have been implementing case based learning, or "active learning" (Boisjoly & DeMichiell, 1994). The research goal is to explore a topic or an idea and gain an insight into a target audience's lifestyle, culture, motivations, behaviours and preferences and with proper rigor and skill it will become valid and reliable. In the end, some existing research about Khan Academy are shown in the methodology followed by some results.

Third, an inductive conceptual model will be defined thanks to the analysis of Khan Academy case study and the existing literature. Hence, an empirical analysis will illustrate in details all the characteristics of the conceptual model, how they will impact within the education system, and final evidence.

2. Literature Review: Incremental Innovation and Disruptive Innovation

The aim of this chapter is to show the reader that previous study have been conducted about changes in education. In particular, is important to understand that we are in a technological revolution that is changing every context of human activity and we need to re-think an education system based on the vision to be dynamic and ready for changes.

If we think about education, whatever we are offering in our schools today will define the competence and character of the next generation, which will have the responsibility of shaping and serving the society in the next century. Most of people share the same thing about our schools today, they are far away from the concept of growing future generation and this is not because government are not spending enough money on education. Most of countries spend a high percentage of their GDP on education, the problem is that they are focusing on improving the existing system. In times of dynamic changes, Reigeluth (1994) *"we should explore change and renewal from the larger vistas of our transformed society, envision a new society and an image of education that will create that society, design a new system based on the image, and develop the system that brings the design to life"*.

This chapter will start with an introduction to the concept of radical and incremental innovation and how this contributes to the creation of value in general and a specific example in the case of education system. In the second part we are going to speak about disruptive innovation and how it will change the way the world learns. In the third part, we will speak about application and case study of ICT in the education system. Finally, the chapter will end with a summary that shows the importance of ICT in the education system.

2.1 The concept of Radical and Incremental innovation

Melissa Schilling defines that the radicalness of an innovation is the degree to which it is new and different from previously existing product or processes, while incremental innovations involves only a minor change from, or adjustment to, existing products or practices.

2.1.1 Advantages and Disadvantages of radical and incremental innovation

Henry Chesbrough, the Harvard professor and a worldwide expert for Open innovation, has stated that radical innovation and incremental innovation are built on different concepts. Incremental innovation focus generally on successive modifications of existing products and service. They help companies to keep up with the competition, maintain profits, and protect market share in the short-term. On the other hand radical innovation are breakthroughs in technologies, business processes or business models, which offer significantly better solution regarding performance and cost than incremental innovations. Radical innovations lead to fundamental and structural change in the market and can disrupt the marketplace and competitors in the long-term. Consequently, they create new markets and growth opportunities as well as new power and profit distribution between companies in the market.

In spite of many advantages, radical innovations require a completely different way of process and they show more complexities, uncertainties and risks in technology, market, organization, and resource than incremental innovations.

Christensen (1997) says, "leading incumbents commonly drive successfully incremental innovation or sustaining innovation, but they are conservative and ineffective in exploiting breakthrough innovation". In contrast, new entrants can beat the leading incumbents effectively with their disruptive innovations. Typically, disruptive innovations are products with lower performance and less functionality at a much lower price. However, based on gradual improvements in performance and cost, disruptive innovations can be used to replace incumbents in the market.

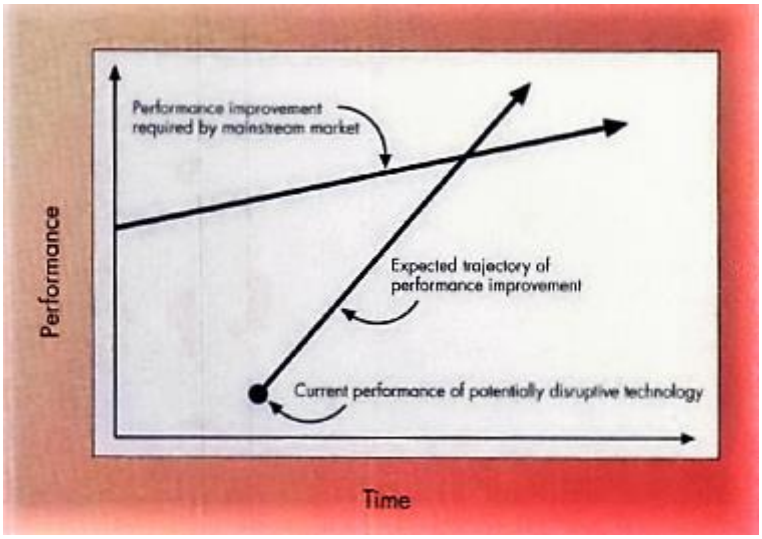

Figure 1 – Disruptive Innovation

2.1.2 The value created by Radical and Incremental innovation in the education system

In social system such as education the most important thing is design a system that is well organized and where shared perspective is needed to ensure collective and internally consistent action. In the book "Systemic change in Education", we found five different principles on which the education system should be organize:

Participation in design of all those who will inhabit the system, and who will be served and affected by it, is a cardinal design principle. Such participation ensures that people will have genuine commitment to the emerging design and to its implementation.

Commitment to idealized design means to create the most inspiring and best possible design, one that will act as a magnet and pull toward its realization. The ideal will be out there on the horizon and continuously guide purposeful move into the future.

Design is learning, and by learning to design and engaging it, we learn as an organization and as individual. As individuals, we learn what contribution we shall make to the whole, and as an organization, we learn to re-examine continuously our collective values, perspectives, purposes, and modes of operation.

Design never ends. New realities emerge, the context in which the system is embedded change, our perspectives change, and thus the ideal will change, as we reimage it in light of emerging changes and aspirations.

Commitment of nurturing human quality. The system is design for the human activity system, in which human beings are the most valued and are to be served by the system. It is in the power of people to guide their own evolution and the evolution of the system to grant a better future for all, and create system of education for future generation.

After designing the organization is necessary to define how we can evaluate an education system systematically. What we read in the existing literature is that most people believe that "the only hope for bringing about educational reform lies in the effective application of the key concept and technology that are embodied by system design." Evaluating educational program is the most reasonable way to inform learners about their progress, to inform educators about their program effectiveness, to inform the public and to create a measure of accountability that can be achieved.

Jenks (1990) create a framework for evaluation planning. It proposes three general interactive phases – design, development and implementation, and evaluation.

In the *Design Phase* is necessary to *identify core values and guiding principles to be utilized during the design process***.** The first task of system design of education is to forge an image that will guide the design of the system. An image is made up of and reflects the core values and ideas of the educational system's stakeholders concerning learners, the learning process, and the nature of the relationships among the educational system, its community, and the larger society. From the image, we need to *establish organizational purposes and learner goals*. Purposes might be limited to those having to do with providing learners with knowledge and skills required to ensure employment or enter higher school education. Alternatively, they might expand the role of the educational system to include such purposes as creating lifelong learners, developing each learner to his or her capacity, or serving the needs of the community for adult education, health and recreation, etc. To create this function, we need to answer the following question: Do learners' goals reflect the community's concern about the current and future needs of learners, for informed participation in the life of the community and the society, and for economic productivity? The third step will be to *define the functions to be performed so that the system's purposes might be served*. This is an extremely important step in the design process because it provides a degree of specificity and clarity about the emerging educational system and facilitates testing. Then we must *describe the preferred learner system* defining the roles of educational staff members, roles of learners, teaching/learning strategies, instructional resources and involvement of community and other non-educators in the learning process. The last step of the design phase is to *describe a support system necessary for implementing and sustaining the learner system*. That is referred to governance, management, decision-making, assessment, information required, resource acquisition and budgeting.

During the *Development and implementation phase*, incrementalism represent a realistic and powerful strategy compared to implementation. It is realistic because resources are almost never sufficient for any other approach, and it is powerful because it permits the organization to learn along the way, to modify, or to redesign based on experience.

Evaluation serves the organization's needs to test three primary system variables:

- The appropriateness of its design;
- The congruence between its chosen design and its operation;
- Its performance in terms of expected outcomes.

2.2 Creativity and Disruptive Innovation

In her book Melissa Schilling define Creativity as the ability to produce work that is useful and novel. We all know that individual creativity is influenced by intellectual abilities, knowledge, style of thinking, personality, motivation and the environment. Melissa defines organizational creativity as function of the creativity of individuals within the organization and the social processes and contextual factors that shape how those individuals interact and behave. The methods to encouraging organizational creativity is collection of idea, organize creativity training programs and create a culture that encourage creativity.

Amabile (1988), states that within every individual, creativity is a function of three components: expertise, creative-thinking skills and motivation. Expertise is knowledge (technical, procedural, and intellectual), creative-thinking skills determine how flexibly and imaginatively people approach problems and motivation. The latter is divided in two different type of motivation. Extrinsic motivation comes from outside a person and usually is represented by boss promises to reward people financially or threat of being fired, on the other side intrinsic motivation is all about passion and personal interest. When people are intrinsically motivated, they engage in their work for the challenge and enjoyment of it and the work itself become motivating.

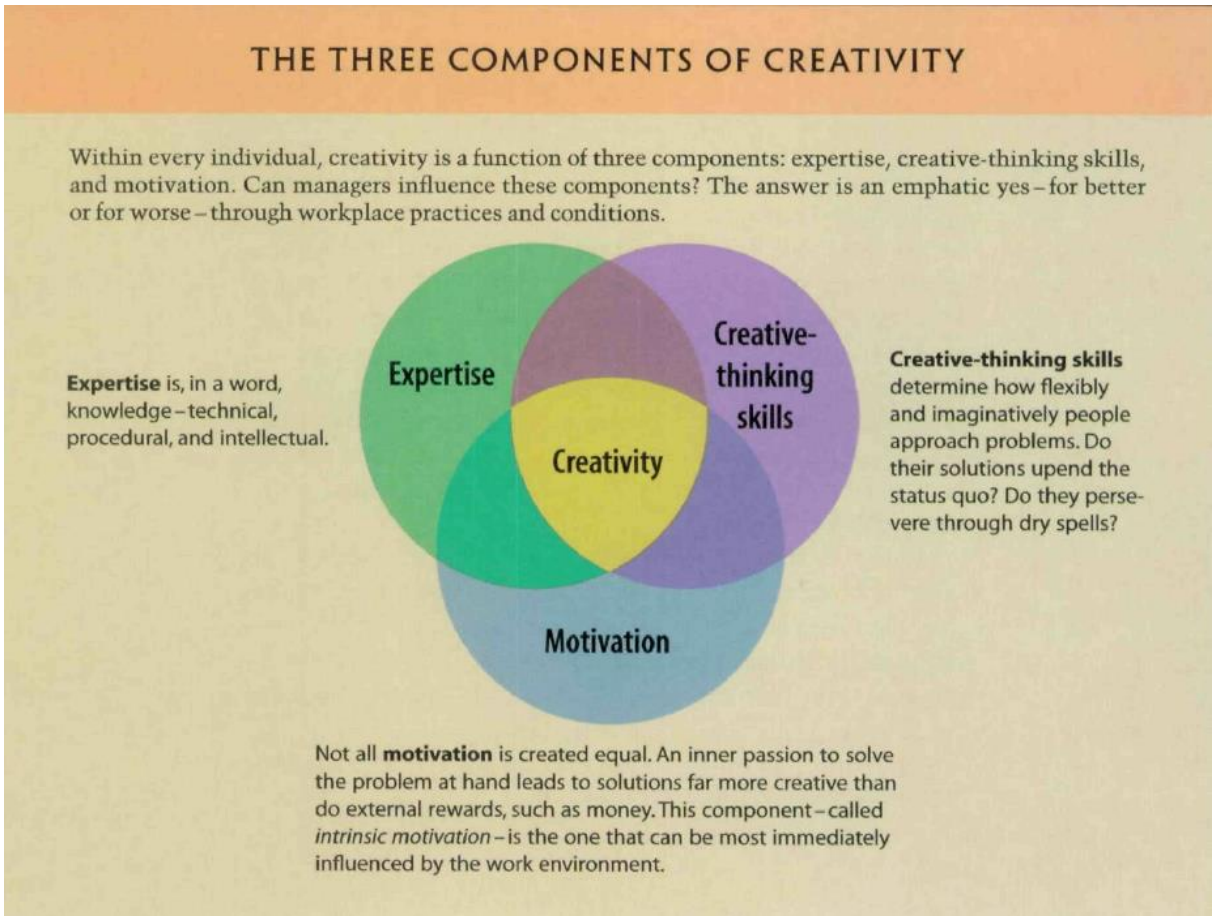

Figure 2 – How to Kill Creativity

In the previous paragraph, we spoke about "the innovator's dilemma" saying that leading incumbents are conservative and ineffective in exploiting technology breakthrough. This is mainly because they are frightened of being wrong. When we speak about education, we refer to children and kids and we know that all the kids have in common one thing, they are not frightened of being wrong. I am not saying that being wrong means to be creative, but what I say is that kids come up with original ideas and by the time they get to be adults, most kids have lost that capacity. What we read in the existing literature is that we are now running the education system where mistakes are the worst thing you can make and because of this, we are educating people out of their creative capacities.

2.2.1 The disruptive innovation in schools

In other books, we find education experts that explain how the best practices of disruptive innovation can be applied to the school education system. More specifically, they examine how to use information technology more creatively to deliver customized education. In fact, Christensen (2008) states that schools exist to maximize human potential. Their aim is to develop skills, capabilities and shape the attitudes of students. Therefore, they must help children to think differently and encourage the development of multiple perspectives. In the literature we find interesting theories of learning and a key point is that everyone tends to learn in our own ways using different methods, different styles, and at different speeds. The typical one-size fits all approach can be dysfunctional for most of the students and learning should be aligned with our

intelligence. But what is intelligence? At the moment intelligence is most often referred with IQ, while if we use the definition stated by Howard Gardner intelligence is:

- The ability to solve problems that one encounters in real life
- The ability to generate new problems to solve
- The ability to offer a product or service that is valued within one's culture.

In addition to that Gardner has identified eight intelligences that are linguistic, logical mathematical, spatial, kinesthetic, musical, interpersonal, naturalist.

Unfortunately, schools standardize the delivery and do not customize it taking into account the unique circumstances of different students. For example, students who are not strong in linguistic intelligence find themselves at serious disadvantage in the English or Italian class. And similarly, students who do not have a high logical-mathematical intelligence tend to struggle in math class. The authors of the books write about "The need for a student centric model" that consist in computer based learning, in fact, software can enable students to learn in ways that take into account their intelligence types and speed of learning. Software can combine content in customized sequences and in the process also help teachers move towards more value adding roles. Today, computers have little impact on the way students learn. Teachers continues to deliver instruction in the traditional way and computers are used by students mainly to type reports, to search the Internet for information and local research papers and to play games. In addition to that, teachers use computer to make better lesson and communicate more with parents through emails and blog. This is a good start to introduce information technology in the education system but it leaves a lot to be desired.

Christensen visualizes how computer may disrupt completely the manner in which education is imparted today. He identified that disruptive innovation may proceed in two stages, in the first stage is the introduction of computer based learning and the second stage would be the deployment of student centric technology. In the first stage, that is, *computer based learning*, the instructional method will largely mirror the dominant type of intelligence or learning style in each subject. However, the software may allow students to choose different ways of learning the material. In the second stage, *student centric technology* software is a way to teach in a customized way. As a private tutor can deliver lessons according to the competence of an individual student. Unfortunately, this is usually available only to rich people, the student centric technology will provide a "virtual" tutor to many more students who can't sustain that cost.

Christensen (1997) sustain that Computer based learning must not target those courses that schools consider important and want to teach in-house. It must instead focus on courses that public school would be relieved not to have to teach, but would be happy to offer. He thinks that using computed base courses for core subjects would only meet resistance from teachers' union. A good examples of areas where there is a great potential for IT is offering some advanced courses when teachers are not available, or granting some students lesson when they may not attend school physically for any reason. In addition, for students who have failed in a subject, remedial classes may be difficult to arrange in the physical mode and technology can easily organize an online course. In the long run IT will take over many of the jobs currently handled by instructors and will

push teachers into more value adding roles. Instead of delivering a one-size-fits-all instruction, teachers will spend more time with students to help them deal with their individual problems. This will also require teachers that would be more technology perceptive but able to adapt to the individual learning styles of students.

At the end of the book, we read that the solution lies in the creative use of IT. It must get around the system and take the right opportunities. A disruptive innovation succeeds by focusing on affordability, accessibility, capability and responsiveness. IT can help us move towards and teach students in customized ways. If society can find better ways to deploy technology effectively, the school system, which is failing to deliver today, can be completely turned around.

2.3 ICT in Education

This section presents a discussion of pedagogical perspective and theories about ICT in education. Existing literature states that, there is a clear evidence that teachers' perceptions of pedagogy relating to ICT are often limited to classroom practice. This section provides a broader base for understanding what pedagogy involves and how this might apply to the use of ICT in teaching. Alexander (1992) identifies teaching methods and pupil organization as the two facets of pedagogy. These are included in Alexander's conceptual framework for educational practice where pedagogy is one of seven interrelated aspects and this suggests that the pedagogy of ICT should be understood within a broader framework of educational practice. The processes of planning, teaching, assessing and evaluating, and the knowledge needed for these processes are described in Shulman's model of pedagogical reasoning (Schulman, 1987). According to Shulman, teachers' knowledge bases include content knowledge, general pedagogical knowledge that refers to teaching approaches and classroom management, curriculum knowledge, knowledge of learners and their characteristics, knowledge of educational context including groups, classes, the school and the wider community and in the end knowledge of educational ends, purpose and values.

This list matches many of the elements in Alexander's framework. One of the implications of this model for teachers' uses of ICT is that they need to have sufficient knowledge about the topic or subject. Therefore, they also need to understand how this knowledge will be affected by the use of ICT, in order to make appropriate decision about using ICT with kids. The development in ICT provide very different learning opportunities, and a need to design a new "integrated pedagogy" has been identified (Cornu, 1995). For example, McLoughin and Oliver (1999) define pedagogical roles for teachers in a technology-supported classroom as including setting joint task, rotating roles, promoting student self-management and fostering multiple perspectives. A dynamic model for such a transforming pedagogy for ICT was derived from the Palm project (Somekh and Davies, 1991). The authors identified pedagogical change as the following type of progress:

- From a view of teaching and learning as discrete, complementary activities to an understanding that teaching and learning are independent aspect of a single activity;
- From a sequential to an organic structuring of learning experiences;

- From individual to communicative learning;
- From a view of the teacher's role as an organizer of learning activities to one as a shaper of quality learning experiences;
- From a preoccupation with fitting teaching to a group, to a knowledge that teaching needs to be suited to individuals, which calls for continual self-monitoring to ensure sensitivity to unintended forms of bias and discrimination;
- From a view of the learning context as confined to the classroom and controlled by the teacher to one of the learning context as a supportive, interactive, whole-school culture;
- From a view of technology as either a tutor or a tool to one where it is part of a complex of interaction with learners, sometimes providing ideas, sometimes providing a resource for enquiry, and sometimes supporting creativity.

2.3.1 ICT in primary education

As results of research and development project which investigate effective pedagogy with ICT, it was found that teachers' thinking and beliefs about teaching and learning were linked to what they did in the classroom and to the choices they made in selecting how to integrate ICT into their teaching. A key feature of the more effective teachers was their use of effective explanations. Teachers who favour ICT are likely to have well developed ICT skills and to see ICT as an important tool for learning and instruction. They are also likely to value collaborative working, enquiry and decision making by pupils. Teachers who have reservations about using ICT are likely either to exercise a higher degree of direction or to prefer pupils to work individually. This study also recognized the value of support from the head teacher, or of a collaborative working environment. It suggested that the task of developing teachers' effectiveness in using ICT is a long-term goal and needs to become established as a regular part of their professional development. As new equipment and software become available, teachers will need to develop new skills and pedagogical approaches. It is also important to consider the extent of home use of ICT, and the way this may affect pupils' perceptions of school use. Research suggests that there is a gap between the types of use at home and at school. One survey of pupils in ages between 7-8 and 9-10 found that the most frequent activity at school was word processing, which the pupils found boring, while the most popular activity at home was playing games. As a result, the author suggested that schools should learn from what works at home and allow pupils to work on activities that they find valuable, motivating and worthwhile. Another problem arises from the fact that pupils' computers at home are often far in advance of those they have access to at school. Teachers need to acknowledge pupils' innovative uses of technology at home when developing their practices at school (Comber 2002). There is little evidence in the research literature to indicate that collaboration inevitably enhances learning. Yu (2001) examined the effect of competition in computer-assisted co-operative learning situations on pupils' cognitive, affective and social outcomes, in a study of 192 5gh grade-students ages 11-12 years in six classes in one Taiwanese school. The results showed that co-operation without competition engendered better attitudes

towards the subject matter and promoted more interpersonal relationships. However, studies of pupils using ICT at primary school level suggest that effective pupil collaboration for learning is not easily achieved.

2.3.2 ICT in secondary education

Two of the fundamental differences between primary and secondary schools are in the allocation of ICT resources and the cross-curriculum nature of primary education compared with the subject-specific teaching and organization in secondary schools, ICT is taught as a discrete subject within an ICT department.

The research evidence shows that, in order to integrate ICT into *mathematical teaching*, it is necessary for teacher to have a substantial understanding of ICT resources and familiarity with a range of applications. Effective uses of ICT should enable pupils to focus on reasoning rather than on answers, and enable them to develop significant mathematical strategies and connect mathematical idea with the real world. When teachers use ICT in ways which challenge pupils' thinking and engage them in investigations, pupils demonstrate a higher order of mathematical reasoning and increased attention than when teachers adopt a transmission view of teaching. Another large study involving over 2,000 middle school pupils (Waxman and Huang, 1996) examined whether the degree of implementation of technology in mathematics classes affected outcomes such as changes in classroom organization and interaction, the selection of activities, and pupils' on and off-task behaviour. The results indicated that there were significant differences in instruction in the classroom depending on the amount of technology used. Whole-class approaches, where pupils generally listened to or watched the teacher, tended to be used in classroom where technology was not often used. On contrary, in classrooms where technology was used moderately there tended to be much less whole-class instruction and more independent work this study suggests that the use of technology may help to change teaching from a traditional teacher-centred approach to one that is more pupil-centred. In addition, pupils in classrooms where technology was used moderately were found to be significantly more on task than pupils in classroom with less use. In a meta-analysis, that is a study, which aggregates the finding from many other studies, Clements (2000), describes the unique contribution of computers to problem- and project-oriented pedagogical approaches. His research showed that pupils' collaborative activities resulted in enhanced achievements. An increase in pupils' collaboration resulted in deep conception, and the pupils seeing learning as dependent on thinking and understanding.

The most extensive uses of ICT in education have been in science at both primary and secondary levels. This can be seen through different types of ICT environments such as simulations and modelling. A body of researcher have investigated the extent to which ICT-based simulations can substitute for advanced experiments or experiences in a museum or science centre. For example, Baxter and Preece (2000) found that the learning of 48 pupils between the age of 9 and 10 when they were taught with the aid of computer planetaria was equally effective as teaching with dome planetaria. Pupils worked in pairs at a computer, using planetarium software. The evidence from experimental studies shows that various aspect of achievement can be improved by integrating simulations into topics that pupils find conceptually difficult. The activities set by the teacher involving simulations are often problem solving and enquiry tasks, in which pupils was an outcome

that was encouraged, but not specifically designed, by the teachers, and that the collaboration is one of the factors that leads to improve attainment. Computer simulations of experiments are often used in short episodes in existing curricula. For example, Huppert et al. (1998) conducted an experimental study of the effect of using computer simulations on 10th-grade pupils' (year 11 in the UK) ability to apply their knowledge to the growth curve of micro-organisms. The use of simulations allowed the pupils to carry out investigations more quickly and focus on analysing the results and hypothesizing. The structure of the course helped to create a collaborative learning atmosphere, with pupils comparing results and exchanging ideas. These aspects resulted in gains in cognitive learning.

There are research studies reported in the literature about the effect of ICT on the teaching of art, physical education, religion, humanities and others, but they are very few and provide little new evidence about the effect of ICT use on teachers' pedagogies. There is a need for more research in these areas, especially because of the specialized nature of art and physical education.

2.4 Summary

Radical and incremental innovation has completely change the way companies stay in the market. Leading company usually prefer to increase their product performance by applying little changes every year to their existing product, in this way they can keep their revenues stables and at the same time keep their market share against competitor. On the other side, new entrants can enter the market with something different, a radical innovation that can lead to structural changes in the market and therefore the competition in the long-term. Even if radical innovation looks the most attractive is important to say that it requires a new way of process, uncertainty and risks because most of the time innovative ideas can fail. While incremental innovation is more successful because operates in a market that already exists, that has its market share and then it is easier to maintain profits. In a model of social system, governments prefer to be conservative and do not open to radical innovation, mainly because of the risks that can occur in changing the entire system. In fact, all the reform made in the education system have the objective to improve the current education system. Consequently, we have no improvement in the current generation in terms of openness to change and ability to solve problems. With respect to research context, radical innovation is mainly about design a new model that is based on participation of the entire people involved in the system, by inspiring them to achieve the best design that at the same time must be continuously evolving for future needs. The system must contribute to the learning of the single individuals and at the same time of the entire collectivity and we must always think about nurturing human quality, because the people guide their own evolution and the evolution of the system will guide our future generation.

Literature explains that we need to support innovation in the traditional schooling, change the learning environment, rethink an educational model and how we plan education. In order to do that is necessary to define a different concept of creativity and intelligence. Creativity is the ability to invent something that is useful and novel, Amabile in her paper sustain that individual creativity is influenced by motivation, extrinsic

and intrinsic, expertise and creative-thinking skills. On the other hand, intelligence is most often referred to IQ instead of, as Gardner says, the ability to solve problems, the ability to generate new problem to solve, the ability to offer a product or service that is relevant within one's culture. Gardner also sustain that different types of intelligence exists and they are specific on each person, one person can be more effective in logical and mathematical thinking while other people can be better on language or arts class. Most schools tend to deliver a common learning to every student without consider that every student own their specific type of intelligence and may need his/her proper way to learn a specific subject or even a single issue.

Literature then, define how disruptive technologies can be applied in the education system. Christensen sustain that the involvement of ICT in schools can enable student to find their personal way of learning and at their own pace. He argues that, at the moment computers are not used properly in schools, in fact, they are mainly used by students to write report, do some research in the Internet or to play games. Teachers also, to improve the relationship between teachers and parents and to make better lesson use computers. Christensen affirm that the potential of ICT in schools is huge and must not be limited to these functions. He defines two ways in which disruptive innovation may enter the education model, the first stage is the introduction of *computer based learning* in which the software will give the students the opportunity to customize the way of learning the material and it will be based on student's type of intelligence and learning style. In the second stage, that is student centric technology, students will be able to have a "virtual" tutor that will deliver lessons according to the competence of every single student in a way much cheaper than traditional tutor will. In his work "the innovation Dilemma", Christen shows the main areas where there is a great potential for IT. First of all, the possibility to organize some advanced courses when teachers are not available, then by granting students the possibility to attend lesson when they may not attend physically for any reason and the finally opportunity to arrange online courses for students who need remedial lesson to recover an exam they have failed.

Then, literature brings us in the specific case of the Italian education system in which even if the project contains good ideas for the future of learning, it was not possible to determine any trends because of the little statistic sample but mainly because the criteria adopted for each school were different from one and another.

The aim of this chapter was to explain the importance of ICT in the education system. As we have seen the existing literature really care about radical changes and the introduction of information technology within schools. Many advantages emerge from the readings, both for students and teachers, and they are related to the possibility to customize every student way of learning and at the same time help teacher to help students directly avoiding as much as possible the one-size-fits-all relationship. The teachers' perceptions of ICT are based on the benefit that ICT can bring to teaching and learning, particularly in terms of pupils' outcomes. The teachers considered that ICT could make an important contribution to schools, helping the teaching and delivery of the curriculum in a number of ways:

- ICT can help teachers make the lesson more interesting;
- ICT helps teachers explain thing more clearly to learners;

- ICT can be used in most curriculum subjects;
- ICT encourages teachers to vary the ways in which they organize pupils in their lessons, for example computer partners, pairs, larger groups.
- Teachers can prepare for relevant activities beforehand;

Teachers reported that the use of ICT had many benefits for learning. One of theme which emerged strongly was that pupils could control the learning process and see the results of their actions and decisions. Other specific example of benefits arising from learning with ICT included:

- Pupils can change variables in mathematics and investigate mathematical relationship interactively;
- Simulations help pupils to distinguish and control variables;
- Pupils can change one variable at a time in a simulation;
- Pupils can collect data and do an experiment on an interactive whiteboard;
- Using simulation challenges conceptual understanding;
- Pupils can hypothesise and predict outcomes of processes;
- ICT enables pupils to learn how to explain things to others;
- The teacher can focus on the more important task of helping pupils in scientific thinking;
- The use of interactive whiteboard helps the teacher introduce the theory behind topics;
- The use of ICT encourages pupils to reflect on their own work;
- ICT enables pupils to evaluate their own and others' work;
- Having to explain an activity to others requires clarification in pupils' own minds;
- Pupils can access more knowledge during school time.

However, all the evidence shows that these benefits are dependent on the way in which teacher selects and organizes the ICT resources, and how this use is integrated into other activities in the classroom and beyond. The crucial component remains the teacher and their pedagogical approaches. Examples of the specific uses of ICT most frequently reported in the literature include, simulations and modelling in science, software in mathematics, word-processing for language, the internet to extend pupils' subject knowledge, presentation software to develop pupils' presentation and literacy skills and interactive whiteboard to promote class discussions. The overall conclusion from the research literature is that ICT is used effectively and has an impact on learning where teachers are able to appreciate that interactivity requires a new approach to pedagogy. Teachers need to employ proactive and responsive strategies in order to support, guide and facilitate learning. They need to monitor progress and maintain a focus on subject learning, by structuring activities carefully and providing focused tasks.

3. Methodology

This chapter describes the research method that is used in order to find answer to the research questions. A short research overview will introduce this chapter, followed by a research design that will include the methods used to collect data and finally this chapter will end with a discussion on the validity and reliability of results found in this study. Therefore, the aim of this chapter is to define which data and methods have been used in order to answer those questions: "How can we use technology in the education system", and the following sub-research question "do technology stimulate creativity through education?" and "how technology will improve the education system?".

Within the education system is not easy to find schools that are technologically advanced or at least is not possible to find a sample that is as big to create a benchmark. Because of that, as we read in the existing literature, most of the research came from experiment or simulation made by scientist about children or teachers and how they interact with technology. The population would be too small to create strong conclusion from a quantitative approach and therefore I choose to analyse my thesis with a qualitative approach.

3.1 Qualitative method

Creswell (2009) illustrates the characteristics that might be used in a qualitative research. Researcher tend to collect data in the site where participants experience the issue or problem under study, that is called natural setting and the researcher must interact the problem face-to-face over time. The researcher become a key instrument in the sense that they collect data themselves through examining document, observing behaviour, or interviewing participants. In addition to that, gathering multiple forms of data and make sense of them all together become important, and this is when researcher make an interpretation of what they see, hear and understand. This interpretation cannot be separated from their own backgrounds, history, context, and prior understanding.

The qualitative researcher today faces an array of options for conducting qualitative research. Numerous inquiry strategies (Denzin & Lincoln, 2005), inquiry traditions, qualitative approaches (Miller & Crabtree, 1992), and design types (Creswell, 2007) are available for selection. Typically, qualitative discussions focus on paradigms, on theoretical overviews, or on identity and moral agency, and researchers are left without guidance as to how to proceed with an inquiry. Creswell, (2007) and Creswell and Maietta, (2002) discussed and contrasted five popular types of qualitative designs, highlighting the procedures involved in actually conducting qualitative studies. The five qualitative designs are: narrative research, case studies, grounded theory, phenomenology, and participatory action research (PAR). In a case study the research question is about developing an in-depth understanding about how different cases provide insight into an issue or a unique case. In the next chapter, we will discuss about the importance of case studies.

3.2 The importance of Case Study

Case study research, through reports of past studies, allows the exploration and understanding of complex issues. Recognised as a tool in many social science studies, the role of case study method in research becomes more prominent when issues with regard to education (Gulsecen & Kubat, 2006), sociology and community-based problems. Tellis (1997) says that case study helps explain both the process and outcome of a phenomenon through complete observation, reconstruction and analysis of the cases under investigation. Case study method enables a researcher to examine closely the data within a specific context. In most cases, a case study method selects a small geographic area or a very limited number of individuals as the subject of study. In addition, explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationship.

Case study can be single or multiple-case design. Yin (1994) pointed out that generalization of results, from either single or multiple designs, is made to theory and not to populations. There are several categories of case study methodology in the literature. Yin (1993) notes three categories, namely *exploratory, descriptive and explanatory* case studies. In any case, is important to say that there are different advantages in using case studies:

- The examination of the data is most often conducted within the context of its use, that is, within the situation in which the activity takes place.
- Variations in terms of intrinsic, instrumental and collective approaches to case studies allow for both quantitative and qualitative analysis of the data.
- The detailed qualitative accounts often produced in case studies not only help to explore or describe the real-life environment, but also help to explain the complexities of real-life situations which may not be captured through experimental or survey research.

Despite these advantages, case studies have received criticisms. Case studies are often accused of lack of rigour, Yin notes that "too many times, the case study investigator has been sloppy, and has allowed equivocal evidence or biased views to influence the direction of the findings and conclusions". Case studies provide very little basis for scientific generalisation since they use a small number of subjects, some conducted with only one subject. A common criticism of case study method is its dependency on a single case exploration making it difficult to reach a generalising conclusion (Tellis, 1997).

Case study have been increasingly used in education, in fact, schools of business have been implementing case based learning, or "active learning" (Boisjoly & DeMichiell, 1994). The main characteristic of case studies is that they want to find a holistic understanding of cultural system in action (Feagin, Orum & Sjoberg, 1991). The unit of analysis is important in the case study, it is not about a single individual or a group of person but is more about the entire system that is examined. In addition to that, case studies tend to be selective, focusing on one or two topics that are fundamental to understand the whole system.

In the next paragraph we are going to identify the main component to set a design research and what instruments will be using to collect data.

3.3 Data Collection

Yin (1994) states that a case study investigator must be able to operate as a senior investigator during the course of data collection. There should be training about the examination of the definition of the problem and the development of the case study design. In our thesis data is gathered by analysing students and their approach with computer. A case study protocol contains more than the survey instrument, it should also contain procedures and general rules that should be followed in using the instrument. A typical protocol should have the following sections:

- An overview of the case study project (objective, issue, topics being investigated)
- Field procedures (credential and access to sites, sources of information)
- Case study questions (specific questions that the investigator must keep in mind during data collection)
- A guide for case study report (outline, format for the narrative)

The overview gives to the reader the general topic of inquiry and the purpose of the case study. The field of procedures includes data collection issues and must be clearly designed. The investigator does not control the data collection environment as in other research strategies. Hence the procedures become all the more important. Case study does not have a unique framework, the questions made by the investigator serve to remind that person of the data to be collected and its possible sources in order to avoid a problem of reliability.

Stake (1995), and Yin (1994) identified at least six sources of evidence in case studies including documents, archival records, interviews, direct observation, participant-observation and physical artefacts. In this study, documents, direct observation and participant-observation are used.

- Documents can be letters, agendas, newspaper articles that are useful to support the evidence from other sources. In this case, public documents about technology in education and various publication are included in the thesis. These documents are communication between educational researchers and students.
- Direct observation occurs when a field visit is conducted during the case study. It could be as simple as casual data collection activities, or formal protocols to measure and record behaviours. This technique is useful for providing additional information about the topic being studied. The reliability is enhanced when more than one observer is involved in the task.
- Participant-observation makes the researcher into an active participant in the events being studied. This often occurs in studies of neighbourhoods or groups. The technique provides some unusual opportunities for collecting data, but could face some major problem as well. The researcher could well alter the course of events as part of the group, which may not be helpful to the study.

3.4 Validity and Reliability

As mentioned earlier, this research is based on qualitative data, and this means that we can explore topics in more depth and detail than quantitative research but at the same time, it is not generalizable as

quantitative analysis because of the small sample taken in consideration. In terms of validity, we have already said that in the education environment a qualitative method is the best way to analyse the context because it is more subjective, it describes a problem or condition from the point of view of those experiencing it. The research goal is to explore a topic or an idea and gain an insight into a target audience's lifestyle, culture, motivations, behaviours and preferences and if the researcher utilise the proper rigor and skill it will become valid and reliable.

Therefore, in the following paragraph we are going to talk about Khan Academy's existing case studies about how technology is used in the education system.

3.5 Khan Academy

Khan Academy (KA) is an education website most known for its collection of videos. KA offers practice exercises, instructional videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom. It offers a variety of subject starting with math, science, computer programming, history, art history, economics and more. His mission is to guide learners from kindergarten to calculus using state-of-the-art, adaptive technology that identifies strengths and learning gaps. Salman Khan, founder of KA, started this idea putting videos on YouTube to help his cousins learning math. He just wants to give them a supplement, something that might give them a refresher or something. Therefore, as soon as his video were on YouTube people from anywhere start giving feedback like "First time I smiled doing a derivative", and more important parents were saying that their children were understanding thanks to his video.

Khan realized that he created a good supplement, that is good for motivated students and have potential for home schoolers but he never thought that it would be used in the education system. He started getting letters from teachers writing that they used his video inside the classroom and assign the lectures for homework. What was used to be homework, now the students are doing in school. The teachers using KA have two main benefit, the first one is that now their students can enjoy the videos, they can pause, repeat at their own pace, at their own time. The second one is the unintuitive thing about technology in the classroom, by removing the one-size-fits-all lecture from the classroom and letting students have a self-paced lecture at home. Then, when you go to the classroom, letting them do work, having the teacher walk around, having peers actually be able to interact with each other, these teachers have used technology to humanize the classroom.

In the empirical analysis, we are going to analyse a sample of subjects available on KA website and understand why those videos and these exercise can increase learner's performance compared to the traditional education system. In addition to that, is necessary to understand the instruments that teachers can use through the KA platform. For example, the coach's dashboard where teachers can see every single kid's situation, if children are understanding a certain topic or if not and intervene on single kids. Alternatively, even better, take a kid who is already proficient in that concept and use it as tutor for his/her peer. The last tool that we are

going to analyse is the merit badges system that is on the website in order to stimulate competition between children.

3.5.1 Existing study on Khan Academy

Founded in 2006, the non-profit Khan Academy one of the most popular education websites, and its mission is providing "a free world-class education for anyone, anywhere." KA is a digital learning organizations in education and is in rapid growth because of his quality online instruction and the value that KA provides to its users. Although it originally focused on helping individual users learn on their own, outside of schools, KA now is working closely with schools to explore ways of transforming how instruction is organized, delivered and experienced by both students and teachers. KA offers more than 5,500 instructional videos and it offers more than 100,000 practice math problems that students can complete at their own pace. Recently, KA introduced additional coaching features to guide teachers, tutors, parents to meet their students' learning goal.

The existing study involves nine sites, 20 schools, and more than 70 teachers over the course of school during the school year 2011-2012 and 2012-2013 to understand how KA could be used as a supplemental educational resource in the classroom. The students involved in the study are grades go to primary and secondary school level and they were around 2000 in each study year. The data were collected during site visits, including classroom observation, interviews with administrators, conversation with teachers, parents, and students.

KA's resources were used for different purposes from every site, some schools believe that it must be used as an additional practice tool that intervene only for students who had fallen behind, others thought that KA must be used as an enrichment activity for advanced students and other as a tool for monitoring student's progress. We need to specify that every school begin on different level, based on access to IT infrastructure and levels of comfort of both teachers and students in the use of technology.

In the *first site* analysed the mission was focused on helping students learn how to set learning goals, how achieve this goal and evaluate their own progress along the way. Khan Academy was mandated for all the students during the first year while during the second year, due to a change in the school's instruction, KA was at the discretion of students. During the second year of study, the students used it in a more innovative and independent ways becoming able to self-learn at their own pace. KA in school was the primary resource used to personalize the learning environment for math instruction. During the math class students were working on their own or in small groups, often with laptops. On the other side, teachers become the main support by developing "playlists" to help students during their learning time. A playlist is a set of activities and additional information that were related to the topic students were studying, these playlists were not limited to KA's resources, but includes other website or PDFs worksheet. The high use of KA in the first year 2011-2012, was supported by several factors:

- 1:1 access to computers

- Mandated completion of Khan Academy goals with consequences for failure
- Teachers monitoring of progress toward goals
- Well-planned integration with the core curriculum
- Extended instructional blocks

During the second year, the site wants to understand to what extent student were able to manage their own learning in other areas in addition to mathematics. They understood that, by giving the students more control over resources they used, some of them still need an additional support to do this kind of independent work.

In the *second site* KA was mainly used in order to support the teacher in the whole-class instruction. During the math class, the students rather than using traditional worksheets, they worked online using Khan Academy exercise. The school's strategy is to emphasize students to build a self-discipline and a sense of individual responsibility, and overall work ethic. Teachers can monitor in real time the time students spent on exercises and at the same time their progress, in addition to that, teachers can use the data to show their students if they completed their work and if not how many time they spent on it to understand the topic. Thanks to the rules assigned by teachers, if a student does not finish his assigned work he need to remain after school to finish them, thus he receives additional motivation to stay on task during the school day. The teachers say that "even if student does not care about the grade, they do care about their time", and this penalty helps students to identify and understand how to improve their learning. After two years, the school realize that there was a moderate difference in spring test scores between the students who attended the school before the change in math instruction and those who were using Khan Academy.

The *third site* serves predominantly a low-income population and his mission is to emphasizes the academic preparation for higher education because many of these students are going to be the first in their families to attend college. The strategy used in this school is a "rotation" model mainly because there is no access to computer for every single student. The class was divided into three groups of 8 to 9 students for the rotation stations, one of which was Khan Academy. At a second station, students worked in a small group with a teacher who gave a mini-lesson, and the third group practice independently on math assessment. The students working at the KA's station were able to work at their own pace, they could skip content on which they were good at and move on to new material, or if they were struggling with a concept, they could use hints or watch the video in order to solve their own problem. This is an immediate feedback to the student that usually will wait day or more before receiving feedback or extra help from the teacher. Therefore, with KA, students can clear up their mind and get back quickly and independently to the next topic.

3.5.2 Results of the existing study

What emerges after the analysis of the existing studies is that from a student use and perception;

- Students enjoyed using KA, and a great part of them like math more since they started using technology;
- The level of engagement was higher for the majority of the classroom for all grade levels;

- Feedbacks, hints and access to videos helps students that were struggling and at the same time give them the possibility to learn new things on their own without the help of a teacher.

From teacher use and perceptions:

- Most of the teacher were happy about their KA experience and are planning to use it in the next years and at the same time most of them would recommend it to other teachers;
- A strong majority of teacher reported that the use of KA had positively affected their students' learning and understanding of the material overall;
- Teachers increased their ability to monitor student in terms of knowledge, ability and identifying students who were performing better or struggling on topics.
- Teachers found KA's report very useful

3.6 Summary

In order to answer our research question "How can we use technology in the education system?" is necessary to collect data and methods. In this chapter, we decided that a qualitative approach is the best way to analyse a social system, in the specific case the education system. Qualitative research allows exploring topics and understanding the meaning of an individuals or groups to a social or human problem. This approach differs from quantitative research because is using words instead of numbers, or using interview question instead of hypotheses. The research process includes question and procedure, based on the participant's environment, in order to analyse data referred to particular themes that are interpretable from the researcher.

Case studies approach according to Yin (2003) should be considered when: the research question focus on "how" and "why" question, you cannot manipulate the behaviour of those involved in the study, you want to cover contextual condition because you believe they are relevant to the phenomenon under study, or the boundaries are not clear between the phenomenon and the context. Case study research enables the researcher to extract data from a variety of different sources and to manipulate data to make the case clearer. It is one of the most recent and therefore is one of the hardest research method. Researcher suggests conducting some statistical analysis in order to make case study approach more valid and reliable.

The main advantages of case study methodology are: examination of data is conducted within the context of its use, intrinsic, instrumental and collective approaches to case studies are allowed for both quantitative and qualitative analysis and information produced in case studies helps to understand the complexity of real-life situations that cannot be captured through quantitative analysis.

The main critic to the case study method is its dependency on a single exploration that makes difficult to reach a general conclusion. In order to collect data is necessary to create a protocol that contains general rules and procedures that should be used during case studies. A typical protocol includes an overview of the case study project, field procedures, case study questions and a guide for case study report. Therefore, the main evidence that are used to collect data are documents, archival records, interviews, direct-observation, participating observation and physical artefacts.

To have a quick recap, the necessary data for answering our research question will be extracted from the qualitative analysis of the case study on Khan Academy. Data collection through these case is guided by the innovation process of re-thinking the education system because, as we have seen from the literature review, at the moment, it is needed. As we will see in the next chapter, the study will identify all the specific changes and relevant evidence of the importance of ICT in education.

4. Empirical Analysis: Technology in the Education system

This chapter aims to answer the sub-questions that are in the introduction: Does technology stimulate creativity through education? How will technology improve the education system? The theories that are described in the literature review identifies the need to create a new approach to pedagogy, where teachers need to be proactive and facilitate learning. In order to answer this questions, this chapter presents an analysis of Khan Academy that was done in order to understand which are the main tools used to improve the education system and which features characterize this technology environment. First however, is necessary to define the research context to understand what is the approach of Computer-Based Learning and all the related advantages and disadvantages. Then, an inductive model will be created thanks to the analysis of Khan Academy and the needs identified in the literature. This model will present a new design for education and his findings will be presented together with comparison to the traditional education system. In the specific, we will analyse the improvement in the education system from the point of view of both learners and teachers through a conceptual model and a questionnaire. Finally, this chapter ends with a summary, which provide the answer to the research question.

4.1 Research Context: An introduction to the computer-based learning

As already was mentioned, technology seems the most innovative way in order to re-think our education system. In particular, all over the world, is necessary to define a new strategy that change the way children learns and professor teach. All over the world, education is usually based on one-size-fits-all lesson where the teacher explains subjects to students and at the end of the term, they got exams about the different topics. This study wants to explain that is possible to rearrange the way the world learns thanks to the introduction of computer-based learning.

Therefore, the Internet, through educational website and the cloud computing platform, become the necessary technology that must be implemented in the education system. The goals of these investments, is to create a dynamic and creative environment that will give the possibility to re-think an education system that is based on the different intellectual ability of every student.

4.1.1 Computer Based Learning

Computer Based Learning (CBL), refers to the use of computer as the main instrument of the educational environment. This definition seems to refer to the use of computer in a classroom, the term more broadly expand to a structured environment in which computer are used for teaching purposes. The concept is usually seen as a peripheral element of the experience, if we took for example gaming and web browsing, that is a different way of learning but is not based on the use of computer. Since its introduction there is a debate, with arguments both in support of and against Computer Based Learning.

Among the advantages by the proponents of CBL there is the ability to provide quantifiable and instantaneous feedback for its users. It also gives the possibility to educators to measure the progress in an

environment that is more structured compared to the traditional education model. In particular Computer Based Learning is seen as the most efficient and effective tool to conduct distance education, because a lesson could be created to allows people to study at their own pace, either via Internet or software installed on computer.

Most of the supporters suggests that, the best use of CBL is together with traditional curriculum, it must be a supportive feature of the traditional system, facilitating interest in a topic while developing the technical and information skills related to the CBL learning. In the recent years, companies are now providing CBL products to increase the knowledge of their employees.

The sceptical of Computer Based Learning argue that it is limited to specific subjects and is not as good as having a human teacher because it can only answer in the way it has been programmed. In addition to that, critics sustain that if computer programmer did not anticipate a particular student's question or difficulty, the student may be stuck and unable to learn.

4.1.2 The Internet

The internet has the highest potential to change the way children learns and professors teach. If we move out from the education system, online website are becoming one of the most used tools for the world economy. Revolutionary "start-up" based their business entirely on the web and the biggest company in the world in the last years changed their strategy by implementing a web platform where customers can find information about the product, online shopping and everything else. Going back to education, the Internet is only used to make little research online without changing the education strategy. The goal of this empirical analysis is to show how educational platform and videos can improve the way the world learns.

4.2 Case study: Khan Academy

4.2.1 Analysis and Structure of the Subjects

As we have seen in the introduction Khan Academy is not only a computer-based education system, in fact, thanks to his instrument and the possibility to collect data gives the possibility to approach education in a complete different way, with personal customization of the learning, with interactivity and with the availability of personal tutor.

For this research then, Khan Academy was studied and analysed. In order to make clear what kinds of subject is possible to study within the website, is necessary to explain the structure of one category of the six different subject and explain the method of learning in every different subject.

Mathematics

With respect to mathematics, analysing "Arithmetic" that is most used category is an efficient way to understand why learning math on a web platform is better compared to the traditional education system. The arithmetic category is structured in six different chapters that are: addition and subtraction, multiplication and division, negative numbers and absolute value, decimals, fractions and telling time. Every chapters is then split in different topics with short video, 30 second to 2 minutes, that explain the concept followed by exercises.

The arithmetic chapter also has a mission page that will list the "skills up next for you" by providing mastery challenge and video and exercises that Khan Academy think they will be helpful for you in order to master all the activities.

Science

In the science subject, the choice is on "Biology". Biology is the introduction chapter of science and therefore is the more popular between students, also because you can't study chemistry if you do not have knowledge within biology. The biology course structure has a table of content with the different chapters as we have seen for the math. The main difference in learning science stands in the fact that the learning is divided in videos that are much longer respect to mathematical topics, biology videos are between 5 and 8 minutes and they are followed by paper. Only at the end of the chapter there will be an online test that will value your learning progress.

Economics and finance

For what regards economics and finance, "Microeconomic" is the suggested starting points from Khan Academy. The economics courses are mainly for college students and their course structure is based on videos, articles and graphs, there are not lot of exercises. The approach of the economic class on the website for microeconomic and macroeconomic is not really different from the traditional approach. The implementation of economics into a technology system is about providing video lesson and at the same time giving the possibility to interact between students thanks to the comments on the video that make the study more challenging and at the same time helps peers to share ideas.

The most interesting thing in the economic chapter is the study of "Entrepreneurship" that is taught in a completely different way compared to the university. In this category Khan has decided to update interviews with entrepreneur all over the world, just to make two examples Elon Musk (founder and CEO of Tesla Motors and SpaceX, Reid Hoffman (founder of LinkedIn). That is a complete different approach of study entrepreneurship compared to traditional textbook. Student can listen the personal experience of the most successful entrepreneur and learn from their mistakes and suggestions.

Arts and Humanities

With respect to arts and humanities there is a huge variety of category but the most popular category is the "Grammar" followed by "World History". The section is about the standard American English and the table of content include chapters as the noun, the verb, the pronoun, the modifier and the preposition. The structure of the course is again about videos and exercise after every video, in the other category such as arts and history there will be also articles.

Computing

Computing is one of the most popular subject used in Khan Academy, mainly because it is divided in two big category computer programming and computer science. We are now living in the age of computers

and KA is providing to the users how to code computer programs and how to design algorithms that make computer more efficient completely for free. In this research, we are going to focus on computer programming because is the most interactive subject inside Khan Academy platform because every user can realize different projects that every user can use as spin-offs. Computer programming teach you how to program, drawing animations and games using JavaScript & Processing JS, you can also learn how to create webpages with HTML & CSS and in the end you can also learn SQL and how to query and manage data.

The structure of every course is based on video, video tutorial about coding, paper or articles, exercise and project. The last one will be available to the entire Khan community that will value it and give you feedback in order to improve your coding skills.

Test Preparation

Test preparation is the last subject of Khan Academy and is divided in various category starting from preparation for the college and arriving at GMAT certificate. In this research, is really hard to find a category that most represent the subject in question. Every test is different from the other, what really matter is the structure of the course that is for the most of them with videos, articles and test straight after the video.

4.2.2 Khan Academy Interaction

In order to use Khan Academy is necessary to register into the website, the registration process is easy and immediate. The only information required are email, password and your role, if you are a student, a teacher or a parent. It also gives the possibility to register with Google or Facebook in order to have a faster registration with personal information already included. Your profile is evolving depending on your learning process, in fact, the more you study on Khan Academy the better badges, icons or scores you will obtain.

User Interaction

There are different ways of interaction between Khan Academy and the users. Starting from the *personal interaction* between the website and the final users, everyone in his/her profile has the possibility to look at his badges, progress, discussion, project and if is a teacher or a parent has the possibility to interact as coach. Badges are achievement based on the user's progress and results.

In the progress page every user can monitor progress in terms of skills, videos, activity and be able to see a focus of the lesson learned. In the skills page, you need to select the main subject in order to see your personal progress including your ability in every topic. All of them will be listed with your personal score and with suggestion if you need practice, if you are intermediate or if you have mastered that specific topic. (Figure 3)

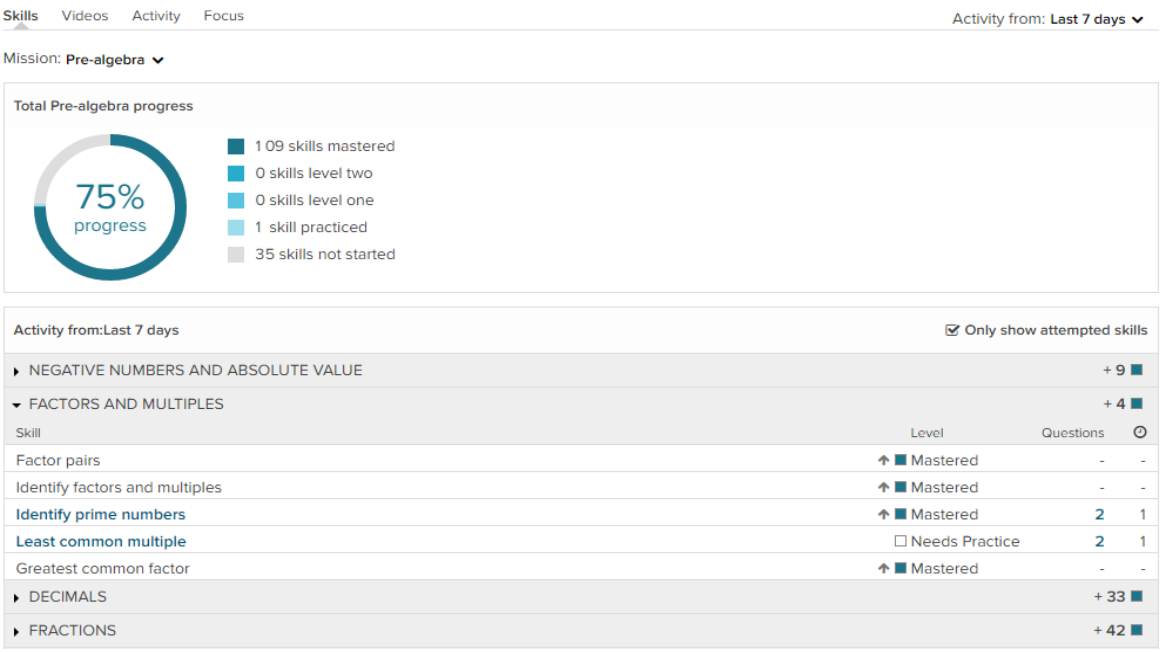

Figure 3 - User Skills

The videos section shows to the users all the video watched in the previous activity within a chosen interval that can be today or last week or all time. The activity page show to the user his/her personal progress with a graphic representation, the correlation is between the activity and the time spent and the energy points earned. In Figure 4, the graph is showing you how many time was spent on skill, video and if you earned any badge. In addition to that, Khan Academy draw a line that shows you how many energy points you have achieved in the past activities. Within a classroom environment energy points can create competition between kids that lead to education challenges that will improve their skills and knowledge.

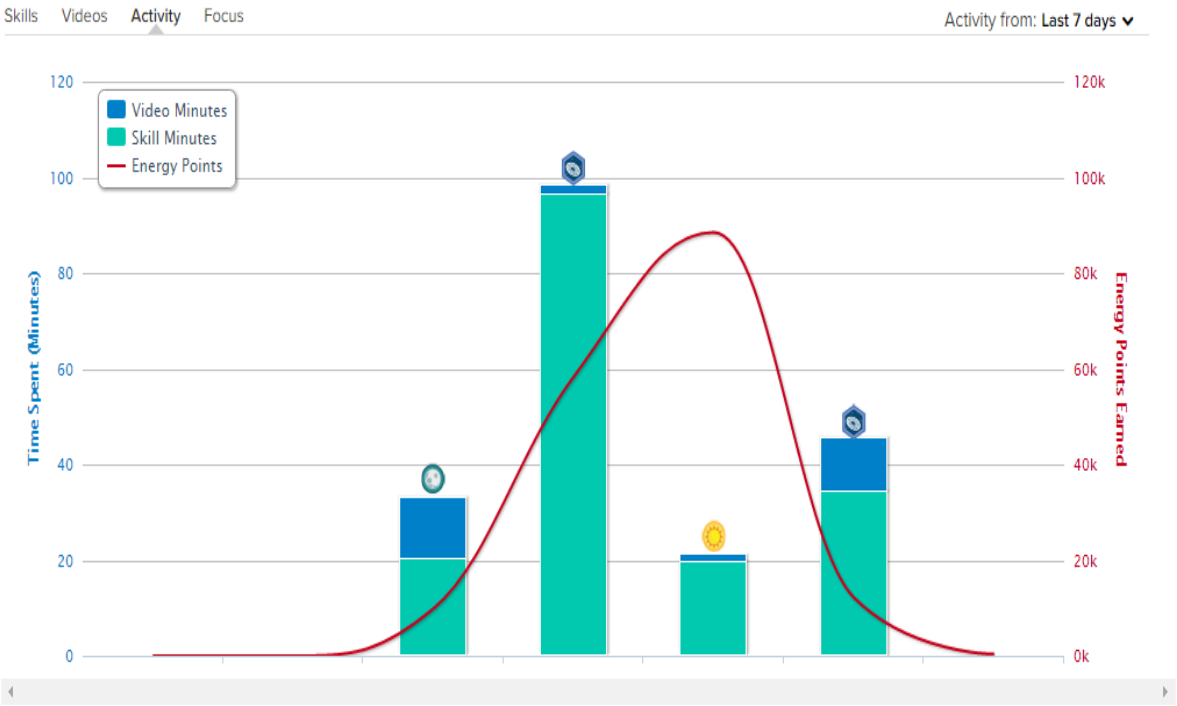

Figure 4 - User Activities

The Focus page is one of the most interesting page because shows pie chart about skills and videos used from the user (Figure 5). Every skill included in the pie chart will say home many time the user spent on the topic, how many problems he solved and how many problems were correct without the use of hints. Inside the pie chart of skills there is another tiny pie chart about videos that shows the topic watched in the video and the time spent watching the video.

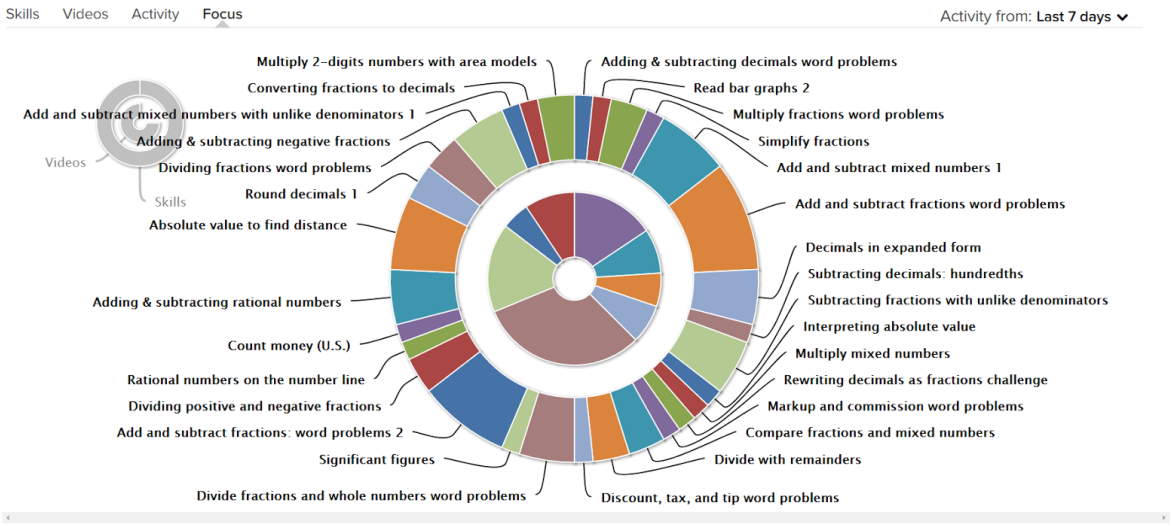

Figure 5 - User Focus

In the discussion page is possible to see all the questions, answer, comments, tips and thanks that the user has posted on the community website. It is the easiest way to control the feedback about your comment or project. If the user does not understand the topic, he can ask question underneath any video and the community of users will help with comments and tips. Therefore, every user can help others by answering questions underneath each video, earn badges and become a teacher in the Khan Academy community. The discussion page also shows you the tip & thanks that user may leave in order to help the community.

The project section shows all the project realized by the user. Most of the project are realized in the computer programming learning, and is possible to use others' user project as spin-off in order to modify or learn new coding rows and improve your own project. In addition to that, you can also comment and vote for the project you like the most and earn badges and points.

Teacher and Parents interaction

The Khan Academy website gives the possibility to teachers and parents to register their own class online or to manage the learning of their children. With five consecutive steps teacher can create their own class, add their students, try the student experience, select the most useful method for their students and finally start the teaching experience by asking their student to log in into Khan Academy.

Is necessary to understand which are the methods that can be used in a computer-based learning. The objective of khan academy is to promote the learning process by motivating student to study at their own pace, by challenging themselves and to have access to high-quality resources. Is really important that teachers let the students know that they have a free tutor available to them during all the day and not only during the

classroom. In fact, when student do not understand a math concept or they cannot attend classes, they can search for specific videos or exercises to recover the lesson. Also, students that want to fill previous gaps in their learning, they can select specific mission or search for specific skills they need help on. In addition to that, curious students that want to explore beyond their regular program can try to expand their knowledge with the other subject for example art history or computer programming.

The level of comprehension and knowledge of a specific subject is different in every student, and even if they have the same teacher you can have different level of knowledge within the same class. Khan Academy website is able to adapt the software and give feedback to every students depending on their grade of study allowing them to practice skills, recognize which one they have mastered, and focus their effort where they are most effective.

The coach interface is divided in seven different section that are Dashboard, manage student, student progress, skill progress, grid, activity and real time. In Figure 6, there is a clearly example of dashboard, every row is a student and every column is one concept. As we can see from the figure there are different colours and they represent the level of the student, in fact, green means that the student is already proficient, blue means they are working on it while red means they are stuck. The role of the teacher become to intervene on the red kids or even better ask to one of the green kids, who is already proficient in that concept to help, to be the tutor of his peers.

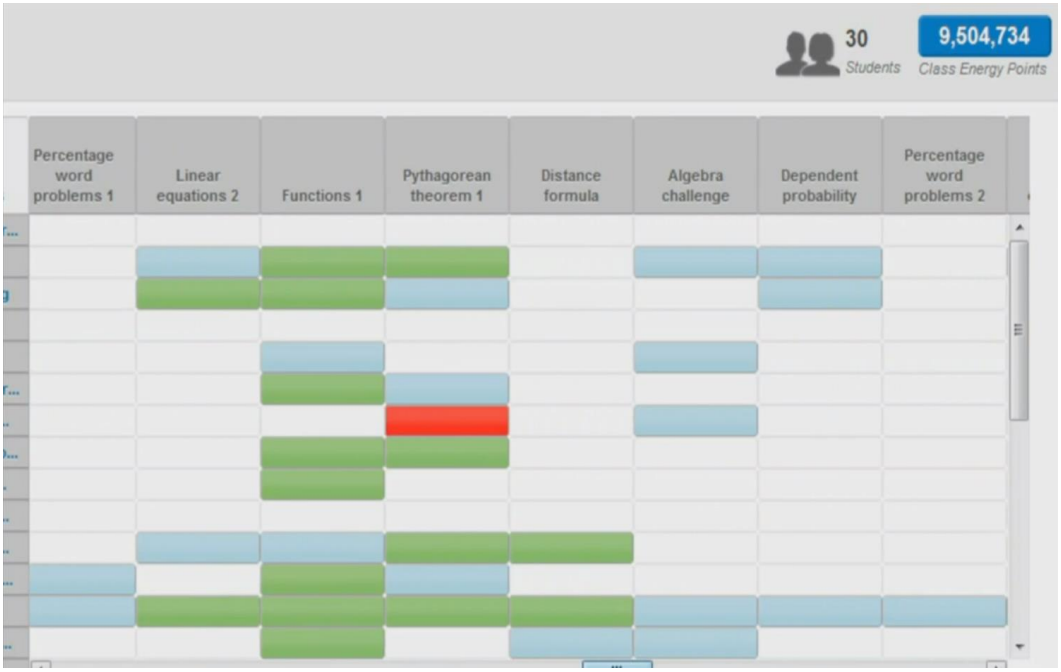

Figure 6 – Teacher Dashboard

Khan Academy is creating a different system of education because it really cares about data, teacher using KA are provided with as much data as possible in order to make a diagnosis of the problem and intervene directly on the exact issue that is creating trouble to the student. Teachers know what students are doing and how many time they have spent each day on exercise, videos and their main focus. (see Figure 7)

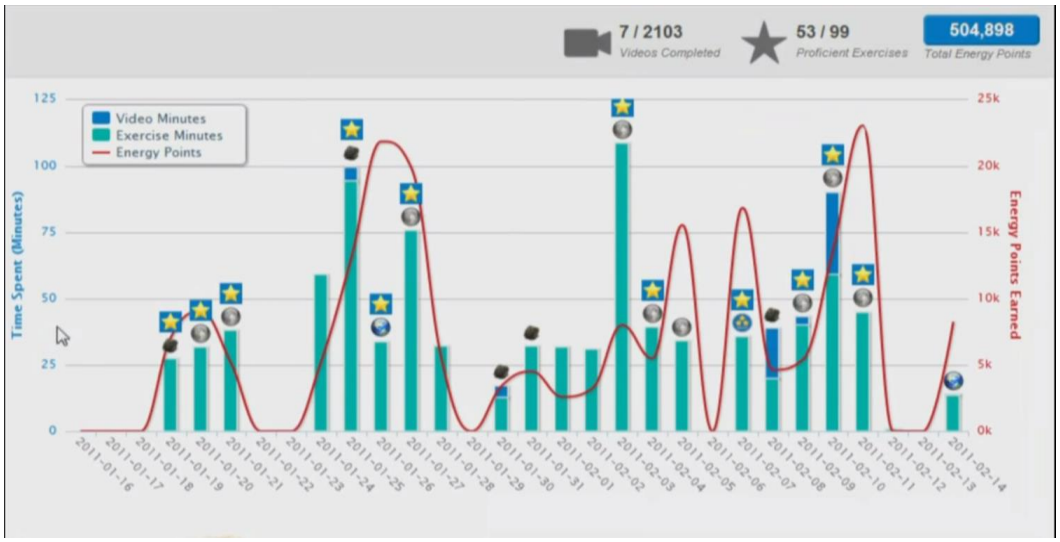

Figure 7 – Classroom Activities

The data can become really specific and as we can see in figure 8 teachers can see the exact problems the student get wrong or right, red stands for wrong while blue stands for right, you can see when they watched the video and in the end you can see when they were able to get 10 in a row and therefore mastered the ability.

Figure 8 - Teacher vista to kid's progress

Teachers can also have a look at the entire class progress and also highlight the progress of a single student, as we will see in the next Figure (9 and 10) the pace at which every student learn is different and the evolution during the year is something really interesting to analyse.

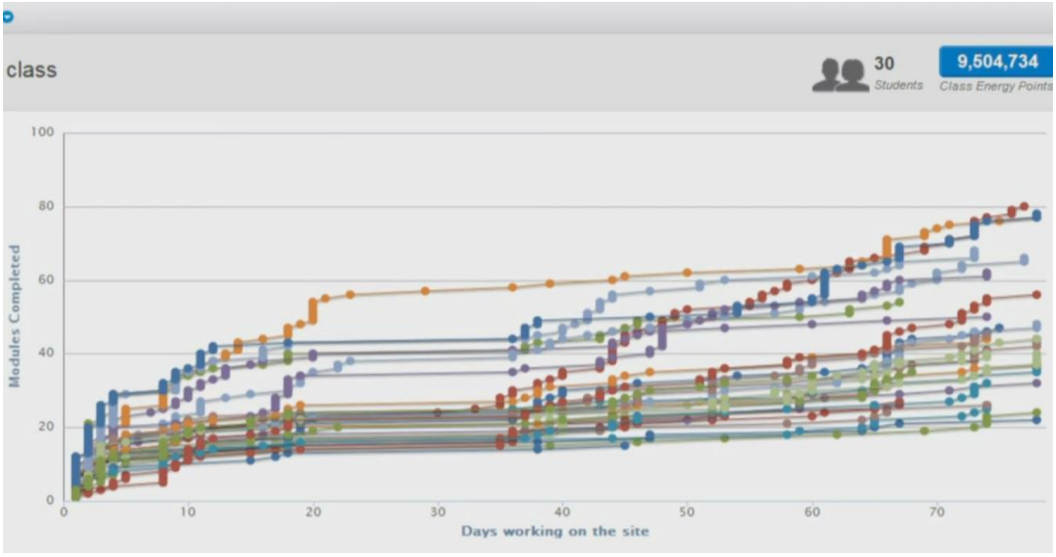

Figure 9 - Class pace of learning

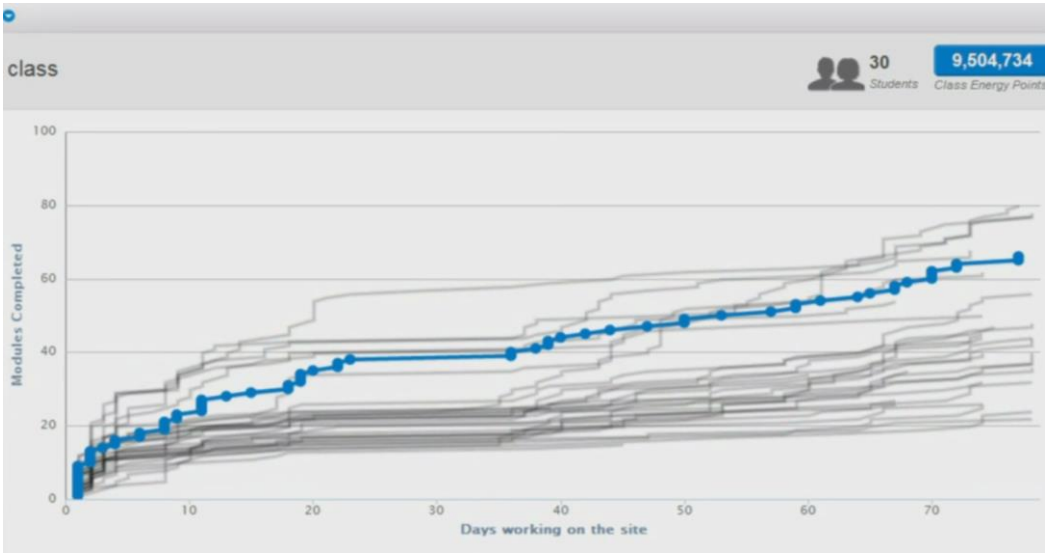

Figure 10 - Single student pace of learning

This is a different approach to the traditional education system. Kids, in fact, are not anymore listening the teacher having a lesson "one-size-fits all" but they are able to study at their own pace with their computer.

4.2.3 Free and available to everyone everywhere

Most of the Computer Based Learning have been developed by companies in order to increase employee's knowledge. This CBL can be found both in the form of Website or Software and they are usually used instead of consultancy company to save costs within the company and be able to have more flexibility in terms of hiring new employees, because any gaps could be easily addressed. There is also a save in terms of time and professional resources, in fact, in terms of professional resources, company do not need to spend any additional money to provide tutor or pay for professional courses to employee. They can learn online instead of taking part of courses that can be much longer respect to the online platform.

The main difference between Khan Academy and this CBL company is the fact that it is completely free and is based on education and not only on professional knowledge, it is online and that means that everybody with an Internet connection can log in and start their learning experience. Khan Academy is available on all the platforms (Internet and Mobile) and give to the users the possibility to have a free online tutor 24 hours every day.

4.2.4 Customization

The customization of Khan Academy can be seen from the aspect of the students and of teachers, in the first case students can personalize their study based on their type of intelligence, on their speed of learning and finally on the badges they want to reach. As we have already seen in the literature, every child develops different type of intelligence, some of them may be good at math more than languages while other can like art and history more than math. Khan Academy gives every child the possibility to study the subject they want without get them into a specific topic that they do not like. Thanks to the video tutorial granted by Khan Academy, every kid can study at his own pace by watching, pausing and repeat the video at their own rhythm without remaining behind the class. They can also decide to move in a direction or another direction based on the points they need to unlock their favourite badge. On the other side, teachers can also create their own assignment and give them to their students, they can suggest to every single student specific video and activities to make them more proficient in topic that are still not clear.

4.2.5 Good Design

The importance of good design is really valuable when you are at contact with kids. Computer users are not willing to tolerate a user interface that is unattractive and inconvenient to use. The fact that many interfaces commonly used in CBL, are less than ideal, may be a contributing factor in the poor performance rates of students in some of these courses.

Khan Academy provide a design that is really intuitive and simple to use. In fact, students can effectively achieve the learning objective and as we say in the interactivity chapter they find really easy to interact with the community and leave additional questions, or in providing answer.

4.2.6 Support feature to the education system

Although CBL is implementing different methods in teaching different subjects it should not be seen as a replacement of the traditional education techniques like lecture, workshops and laboratories. Khan Academy use his website as a support feature of the education system where the teachers can register their entire class and provide exercises and video to reinforce the concept introduced in lectures. As we have seen in the interactivity part teachers have different tools to follow their students during their progress and obtain data and information needed to re-organise their class and intervene on the single student when he is struggling on topics.

4.2.7 Motivator

Many students using Computer Based Learning are used to enter a random answer and then going direct to the correct answer provided by the system to see the final solution. Khan Academy gives the possibility to make several attempts at solving problem rather than giving the final solution, the system motivates the student to think about the problem giving hints and video that explain the problem that are presented in the exercise. The key feature in motivation are the opportunity to interact with the tutorial material, without fear of making mistakes.

The lecture in the traditional system does not motivate student to ask question if they do not understand, the lecture usually does not offer the possibility to interact, and when is possible to interact some students are always scared of public humiliation if they ask a "stupid" question or give the wrong answer to an "easy" question. CBL avoid this kind of situation, children that is shy can ask question and receive feedback without being humiliated in front of everyone.

4.3 Khan Academy users' questionnaire

The intention of this report is to evaluate the results of a survey in which Khan Academy users were asked about technology in education and the main characteristics of Khan Academy. This report outlines the results of a survey conducted to determine the reaction of the users within a computer based learning environment. For example, which subject they prefer to study, if they use the interactivity offered by Khan Academy, if they interact within the community. The main factor that motivate this research is to understand if Khan Academy' users are participating actively on the website and if they find this education system better than the traditional education model or not.

The main objectives that were set out before the start were:

- Understand if computer based learning is useful for all the subjects;
- Understand if users interact with videos, hints, questions and within the community;
- Understand if computer based learning create a self-learning environment;
- Understand if computer based learning should be implemented in the education system.

This survey report was gathered by means of an online questionnaire, in the specific case with the help of google forms. It was sent to the Khan Academy users through the website forum and the different social network, including Facebook and Twitter. On this platform there was not the possibility to send the questionnaire one by one and then it was posted and users were completely free to fill the questionnaire in an anonymous way. The information below summarises the findings of the 60 users interviewed:

- 77% of people were of the opinion to study Math on Khan Academy;
- A significant percentage of users responded that Khan Academy is helpful;
- The majority of users believed that the exercise is on average, not hard nor easy;
- A small proportion of people surveyed use hints while a large percentage reported that they prefer to watch the video;

- 58% of people who do not understand decide to interact with the community and leave comment;
- 57% of people does not receive feedbacks, but the 43% are more than satisfied of the answer;
- Over half of those interviewed leave feedback to other users;
- 100% of people interviewed on Khan Academy study on their own without help of parents or teachers;
- 84,6% of Khan Academy users think that should be used in school;
- The 83% of users on a scale 1 to 5 give to Khan Academy a value of 5.

To conclude, the survey shows that website as Khan Academy should be used the most for teaching Mathematics in schools, the other 23% is divided into computer programming and economics. Most of the people interviewed say that Khan Academy is really helpful because the exercise is on average, not harder nor easier from the traditional school system. On the basis of these findings, it would seem that users watch videos before having activities and this is due to the fact that videos are used by more than average of the users and by the fact that hint are not used most often. The 58% of the people that does not understand interact with the community by asking question and when they receive feedback, that unfortunately is not often, they are more than satisfied. In addition to that, more than half of people interviewed give feedback on the website to other users, trying to answering community's questions. The results of this survey suggest that users study on their own without teachers or parents and most of them think that it should be implemented in the education system.

In general terms an important conclusion is that computer based learning should be implemented within the education system and is demonstrated by the high percentage of users that approved the fact. Users generally study on their own, it is surprising that over half of users interact within the community if they do not understand a specific topic, creating an environment in which people interact between each other, which is shown by the fact that over half of the people interviewed leave feedback to other user comment.

In the light of the results of the questionnaire the introduction of a computer based learning platform would seem to be a good option in order to provide a radical change in the education system.

4.4 Introduction towards a Conceptual Model

As we have already seen in the literature, Information Technology has a little influence on the way students learn. Teachers are using computer to make more efficient lecture and at the same time to communicate easier with parents through emails and blog. Students are receiving instructions in the traditional and standardized way from the teachers with the only difference that they are now able to use computer mainly to type reports, to search on the internet for information and to play games.

In this paragraph, I will introduce a conceptual model that represent a technology self-learning environment. In particular, drawing upon theory, previous research and school case studies, this research will explain why traditional education is not efficient as this model. The specific focus is the application of technologies in school processes, this model could be applied to the education system thanks to the characteristics that were explained above in the Khan Academy case.

4.4.1 Conceptual Model

The conceptual model provides a simple but extremely potent conceptual view of a project. This inductive model implies a timeline (left-to-right) where resources are made available for the work of the project, the work is executed to produce certain outputs and these outputs are then delivered to the final customer.

Outputs are produced by the work carried out during the process phase and are two different types: new products, where none existed before or a change to existing artefact. Outputs can be analysed as the results that emerges from a project, but also, a more important results, are the end-effect generated as a consequence of the implementation of those outputs. Such results are called outcomes. Although outcomes are not displayed in the model, they are extremely important because of their added value. Is important to distinguish whether the outcome is desiderable or undesiderable. The first can be categorized as targeted or fortuitous, targeted outcomes represent the reason for funding the project. Fortuitous outcomes are desiderable effect that emerges from a project even if they were not targeted.

In the end, in the output process is important to distinguish between the concept of “tangibility” and “measurability”. While an output has a high degree of certainty, an outcome is always a measurable effect because is characterized by uncertainty.

Despite the increasing evolution of technologies, we are observing increasing failure in the education system. Business model in education has always been the same in the last century and the plan is always to repeat every year what has been done in the past year, and this is not one of the best business model within the education system. Data are becoming important in every environment, people in fact need information because in every work is necessary to find out if you are obtaining results or you are not. The problem in school is that testing are done at the end of the year and even if they are useful, educators will receive the answer only the next year. It is obvious that, teacher during the next year will not go back to the results of last year but will start the program of the current year without explain to the kids their past mistakes. This section will discuss about the technology inputs, knowledge process and education performance that will result from the model.

In figure 11, the technology inputs, education process and education performance are illustrated in the conceptual model. Below, it will be further elaborated on these functions.

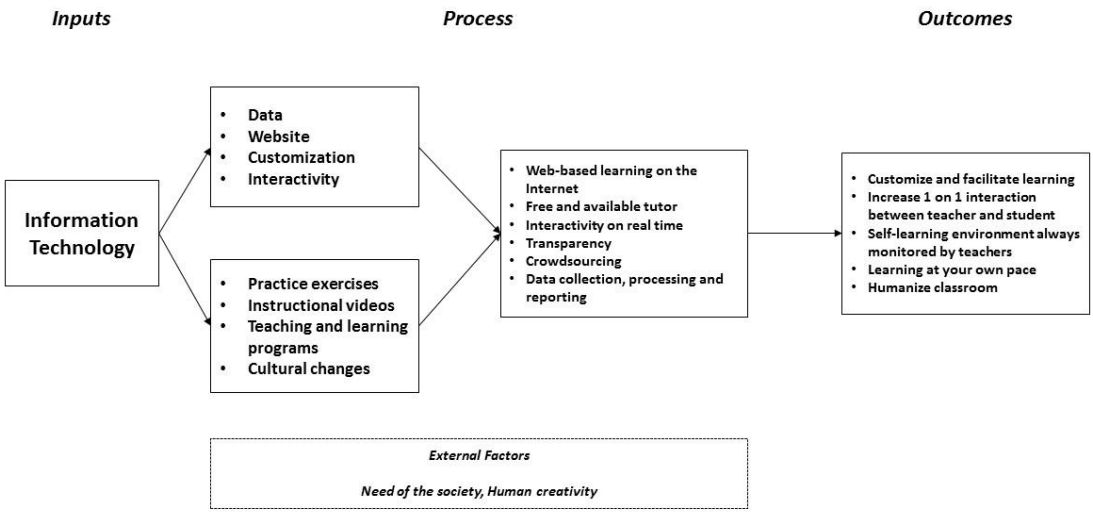

Figure 11 - Conceptual Model

The input-driven paradigm considers information technology, with its primary focuses on technologies such as Web-based learning, database, customization and interactivity. However, the availability of such technologies does not ensure that they positively influence the education system. For instance, if the community realized by Web-based learning do not receive interaction between users it may result in a different way of learning that could be useful, for example without the possibility to receive clarifications outside of the classroom.

The process-driven paradigm of the conceptual model has its focus on teaching and learning program, cultural change, collecting-processing-reporting data, customizing and supporting students. This paradigm consider education as an interactive self-learning environment that is free and available on the internet to everyone during the day, that constantly gives information about the student or users progress and activities. The previous technology mentioned in the input paradigm, must be adopted and utilized in order to serve this processes. The missing link between technologies and processes may often lead to broken systems or outdated as in the case of education.

The outcomes-driven paradigm of the model has its primary focus on creating a self-learning technology environment and therefore, a radical innovation in the education model. Key emphasis is on change the education model by using technologies. It is not about adopting the traditional system but rethink a new one. If the activities created by the conceptual model, such as interactivity, customization and data collection, are relevant in the education system then it is possible to create a new educational model and a cultural change.

4.4.2 Findings of the model

The main characteristics introduced in this chapter about Khan Academy, can led to a radical change in the education model in which the education can be shifted from a classroom approach to a self-learning

environment. This innovation is due to the structure of the course and the interactivity on the Internet. System like KA is developing an innovative way of teaching and learning through computer-based learning, even if at the moment is teaching only 6 different subject. Khan Academy mission is to create a global one-world classroom where millions of students all over the world, learn at their own pace every single day. The website is translated in 36 different languages at the moment. Their partnership with institution like NASA, the museum of modern art and MIT will give them the possibility in the future to offer more and more content. As we have seen in the methodology Khan academy spread his education model in a lot of schools in order to understand if the system is reliable or not. To determine the feasibility of this new innovation is necessary to answer our research question that is "how can we use technology in the education system?"

Customization Evidence

Thanks to the structure of the course and the interactivity provided by the conceptual model the kids will be free to learn at their own pace the topics they like the most. The main feature that will change radically the education system is the possibility to learn at your own pace. In fact, with this model, course structure give the possibility to every student to have a personalized tutor that is available 24 hours a day, every day of the week. There is different point of view about the use of computer-based learning, some think that online platform can substitute teacher while other believe that the platform must exist and cooperate with the education system. However, between the parts there is one thing that is in common: learning. In fact, when children do not understand the lesson, with the use of a clear and short video and with exercises they can learn the topic. The traditional education system does not give the opportunity to student to learn at their speed, the lesson is standardized and they are usually based on the one-size-fits-all approach, where the teacher gives the lesson to the entire classroom without having care of students that are left behind.

Transparency

The implementation of this model in the education system will grant a level of transparency between teachers-parents-students thanks to the Dashboard that could be implemented inside every classroom. This tool will give to the teachers a real-time feedback on the single topic that every students is learning and the evolution of technology in the future will provide more accurate and reliable information about every single case. Another big advantage of the Dashboard is the possibility for the teachers to humanize the classroom, that means children that are already proficient in a topic can help their peers that are stucked on specific topic. In traditional schools this type of interaction is really rare to find, kids that are stucked are usually left behind and kids that are already proficient are bored from the topic they have already understand.

Interactivity & Crowdsourcing

The evolution of technology in the recent years, have seen the development of Social Network that are based on content created by users with the opportunity to share within the entire community. The model gives the possibility to interact to every student that does not understand the topic through videos, hints, question and answer. In fact, if they do not understand properly the lesson explained in the video, they can leave comment to the community and wait for someone to answer. This interaction system is really interesting

because it also includes a voting system based on the quality of your comment that can be voted by the community, creating a competition between students that want to interpret the role of the teacher and see their answer on the top of the list. Within the classroom this crowdsourcing system becomes really valuable and can increase the level of education inside the classroom because it creates competition between kids. The traditional system does not give the possibility to kids to have clarification outside of the classroom, in the recent years, there are some opportunity of meeting the teacher after school, but it is usually once per week.

Data Mining

The main difference between a computer-based learning and the traditional systems is the possibility to collect data. As we have seen in the previous chapter the teacher role will be peripheral but at the same time more relevant. Peripheral because the teacher will give the topic to study and then step back, looking at every kid studying at his own pace on the topic, watching videos, doing activities until they got proficient in it. Relevant because when kids are stucked on a particular topic teacher intervene on the single kid, the educator will become the personal tutor of the single kid and at the same time can use the kids that are proficient in the topic to help their peers that are stucked into it. This is mainly because, thanks to this model, the possibility to collect data will help teachers to receive information about the quantity and the quality of the exercises made by the student and his intention to understand the topic (Did he watch the video to understand the topic? When did he stop the video? In which exercise the children is struggling?). The collection of all this data will help teachers to find a solution in real time.

4.5 Summary

The context of this research is the Computer-Based Learning environment, which is characterized by a different environment in which information technology is used for teaching purposes. The CBL recently has been used by company to train their employees to increase their knowledge and skills without the help of external consultants. This study is focused on Khan Academy, since is the most innovative computer-based learning web platform for education.

The empirical evidence shows different methods to obtain and solve the findings of literature. In the literature was suggested by Alexander (1992) that the pedagogy of ICT should be understood within a broader framework of educational practice and that what is observed in classroom is only part of this practice. He sustains the fact that a good practice in learning and teaching with ICT will require examining teachers' ideas, values, beliefs, and the thinking that leads to observable elements in practice. When looking for these characteristics in the Khan Academy case and in the conceptual model they are all available to play a role in the creation of a better education system.

In the analysis of the case study about Khan Academy different characteristics seems to improve the education model and they are interactivity, transparency, data mining and customization. When looking at these feature they were all included in the Web-learning platform to play a role in the creation of a better teaching and learning experience. The customization for example, gives to every student the possibility to study at his own pace. Moreover, the other characteristics become relevant when linked to the processes of the

education system, the study research shows that the collection of data and their processing and reporting functions create a unique tool that gives the opportunity to teacher to monitor constantly every student and the whole classroom.

Finally, this chapter aimed to answer the question: Do technology stimulate creativity through education? How technology will improve the education system? In order to answer these questions, this chapter presented the computer based learning as research context and an analysis of the Khan Academy case study. In this chapter, the analysed patterns were matched in order to develop a conceptual model. In the conceptual model, information technology is used, as input, in the process of the creating a different education system. The different technology used (including website, data mining, customization and interactivity) must be developed in order to create an innovative learning and teaching environment thanks to the possibility to create a different structure, to customize, to create interaction and to increase the transparency in the relationship between teachers and students. The conceptual model represent an education system based on a self-learning technological environment that must be implemented and supported by the education system. This model must be supported also by the local government, in particular, they must sustain the education system in order to meet the needs of the society and to foster human creativity.

The main differences between the traditional education system and the conceptual model are seen in the different approach to the classroom from a one-size-fits-all approach to a self-learning environment supported by teachers. Regarding this, it can be argued that traditional system is hard to be changed and that technology could not be used efficiently. Subsequently from the empirical evidence and from the findings in the methodology, we have seen that there are different approaches to adapt this model to the resources of the different schools. Finally, the literature was confirmed in the fact that the introduction of computer based learning method will largely mirror the dominant type of intelligence or learning style in each subject and, in addition to that, the student centric technology that is implemented in this model will be available to every student through Internet without sustaining expensive cost in software or in private tutor.

5. Discussion and Conclusion: Re-Thinking Education the self-learning technology environment

The aim of this chapter is to provide a discussion of the findings of the previous chapters, obtained in light of the previous studies reported in the literature and in the Khan Academy case study. The findings of this research will be explained through the conceptual model that came up in the empirical analysis which aim to innovate and improve the education system. For the current education system, this new inductive model is a disruptive innovation that the governments should be willing to accept in order to stop the dropout rate from high school and at the same time, to engage the children that goes to school but do not get any benefit from it. Technology within the education system, gives the possibility to re-think an education model introducing the opportunity to teach and learn in a different way. For what regard the learning opportunity, the development of self-learning environment *"Motivates pupils to learn independently. Continuously provides pupils with opportunities to experience learning as enjoyable and satisfying, to increase their self-motivation. Consistently provides a range of opportunities for pupils to direct their own learning; provides independent learning options, and enables pupils to access these. Encourages self and peer evaluation. Builds pupils' capacity to question themselves"*, Hay McBer (2000). On the other side, the teaching process will be used effectively if teachers are able to approach pedagogy through interactivity. It means that, teachers need to be proactive and act responsive strategies in order to support, guide and facilitate learning. They need to monitor progress, structure activities and provide specific tasks to their children.

Despite the traditional educational model is still solid thanks to his standardization and his increasing trend of testing children, the implementation of technology in education as it has been shown in the empirical analysis, radically change the education system both in learning and teaching in a non-standardized way encouraging creativity and lateral thinking. In this current technological era that is evolving rapidly and is unpredictable, is necessary to train students that will be creative and ready to serve the community of the future.

This chapter will end with the limitations of this study and some suggestions for further research.

5.1 Theoretical implications

The first research question has the purpose of understanding how can we use technology in the education system. This research has found that technology can be applied in several different ways by combining the various aspect of the literature: integrated approach, enhancement approach and complementary approach. This conclusion, also contain empirical support for technology in education and provides evidence thanks to the case study on Khan Academy.

When studying the relationship between school and technology, we see that changing the education strategy find the resistance of governments around the world. Although the standardized model of traditional education is still solid, this research provide evidence that the new design involves all the participants who will inhabit the system. When participants are involved in the design process is possible to create an inspiring

model that engage students to learn as individual and as an organization. Moreover, this new system will be designed for the human activity system, in which human beings are the most valued and like that must be served by the system. On the contrary traditional system are likely to standardize the classroom and increase the number of test in order to create a standard curriculum.

Cornu (1995), says that the development in ICT provide very different learning opportunities and a need to design a new "integrated pedagogy". This study shows the different learning opportunities granted by Khan Academy and the design that best fit the implementation of technology in education: a self-learning environment supported by the teachers. For example, learning on a computer encourage kids to study on their own inside and outside school.

From an economic point of view, the introduction of technology in the education system has the potential to leverage creativity, that means this new model will educate our children in line with the technological revolution that the world is facing. We must remember that, at the moment, we cannot predict the economy of the future, due to the speed of technology, because of that we should educate children in order to be able to predict the future needs, even though they are unpredictable, and to help the entire community.

From an organizational standpoint, this inductive model has the potential to re-organize the learning and teaching experience. Creating an environment in which every student can learn at their own pace, reflecting on their doubts and activities encouraging collaborations and predicting outcomes of learning. On the other side, teachers will have the possibility to obtain data and information on real time about student and classroom progress and intervene on single children when is needed. This will result in a completely different approach between teacher and student.

Hence, it has been interesting to see how Khan Academy decided to implement technology in schools. As a matter of fact, the qualitative analysis was performed in order to understand how KA structure the different courses, how to interact with computer-based learning and which kind of activities facilitate learning. The courses are mainly structure with videos, followed by exercise and at the end of the chapter there is a mastery challenge, in which the children must show his complete understanding of the topic. For what regards the interaction with computer-based learning the possibility to collect data helps student and teacher to see their progress and results thanks to graph and pie chart created by the website. In the end the good design of the website, the customization and the crowdsourcing system will facilitate the learning.

At this point, the analysis will explain the main differences between the traditional education system and the Khan Academy model trying to find answers to the following research questions: "*Do technology stimulate creativity through education?"* and *"How technology will improve the education system?"*

5.1.1 Traditional Education

The traditional education system is in a dominant position and even if every country around the world is trying to improve the system they are always failing in the final delivery. The main reason stands in the fact that their idea is to meet the future needs doing the same things that they have done in the past. The problem is that in the past, children that went to school knew that, if they work hard and go to the college then

successively will get a job, in the recent years, students that have a degree cannot rely anymore on a good job. The traditional education system was designed in the age of the Industrialism where the intelligence consisted in being able to read, write and doing calculation in mind. Education is organized in factory lines with separated facilities, specialised subject and children are educated in age group. This model believes that the growth must be standardized and conform and that testing students will create a standard curriculum.

In traditional classroom, the role of the teachers is to explain to the classroom in a one-size-fits-all approach, that means that the teacher will deliver the lesson and the students must follow and understand the topic. Usually you have homework, lecture, homework, lecture, and then you have an exam and it does not matter which grade every student get, the class will move on to the next topic. The idea of this system is to go forward and create a basic curriculum to all the students, but the problem is that students all of a sudden start failing because they did not understand deeply the concept. Because of that, in the recent years, most of the students are completely losing the interest in schools, some of them drop out from education while most of them are completely not interested in learning.

5.1.2 Khan Academy

Khan Academy is an education website that is trying to change the education model with its collection of videos. This website offers exercises, instructional videos and personalized learning dashboard. The founder, Salman Khan, created this website as a supplement for the traditional education system that is good for motivating student. There are different benefit arising from the use of computer-based learning, the first is that student can enjoy the videos, they can pause and repeat them at their own pace and time. The second is the unintuitive thing about technology in the classroom, in fact, by removing the one-size-fits-all lecture of the traditional education system and let student having a self-paced environment he is completely changing the relationship between student and teacher.

The model provided by Khan Academy is to mastery the knowledge in every specific subject, in fact, the exercises and the different activities encourage students to experiment and fail in order to understand deeply the topic and obtain mastery. The idea is that the teacher goes in the classroom every day and watch every kid works at his own pace, the teacher then, can monitor the students thanks to the dashboard and intervene on the kids who are not proficient or even better ask to student who are proficient in that concept to help their peer. In addition to that, the collection of data in education gives to teachers the possibility to see how many time students spend on one concept or the other.

As we have seen in the methodology chapter there are different existing study on the benefit provided by Khan Academy. What emerges from the analysis of the existing studies is that student enjoying study on KA and the level of engagement is higher compared to the traditional system. The feedbacks, hints and the access to videos helps student who are struggling and at the same time encourage to learn new things without the help of the teacher. In the end, most of the teacher were happy about their KA experience in terms of learning and understanding of their children, in monitoring and identifying students who are performing better or that are in trouble.

5.3 Limitations

During this research, carefully prepared, some good results have been reached even if there are some unavoidable limitations. In addition, the research has followed a qualitative approach, providing case studies and exploratory questionnaires resulting in different biases and the tendency to give desired answers. Although different precautions are taken to improve its reliability and validity there are still some research limitations when reading the results and conclusion of this thesis.

This type of research is suited to answer our research questions but at the same time does not give the possibility to find generalization. First of all, this thesis depends on a single case exploration making it difficult to reach a generalising conclusion. Starting from the existing research of Khan Academy, that has been shown in the third paragraph, refers only to the American education system and gives very reliable findings in the different site that were analysed and they confirmed theory that were mentioned in the literature.

The analysis of a single case analysis, in the specific Khan Academy, does not imply that this model can work in every education system. Subsequently, in order to improve the validity of this study and draw additional conclusion it was necessary to ask to the users of Khan Academy what they think about the computer based learning and his reliability in the education system. As we have seen in the results of the exploratory questionnaire, 60 different people were interviewed but the audience of users was varied and the survey does not indicate the age of the user. This decrease the generalization of this study because the users are not identified in a range of age, they could be children or university student.

The technology in education is an emerging environment in which challenges and risks emerge. This study includes an innovative model of education in which government will be decisive in the strategy. The infrastructure, the Internet and all the related resources provided by local government will affect the education strategy. Therefore, choosing similar cases in terms of organisation and management of resources will improve the discovery of standard and generalizability.

To conclude, the method that was used has some clear shortcomings. Some problems related to the qualitative analysis could not have been prevented. The biggest problems of the conceptual model are for example the support of the government or the different organization that could be adopted in every school but still there is a lot of space to adapt the model at the different resources provided by schools. The first could not be solved in the short-term because is necessary to face a cultural change, while the second depends from every single school.

5.4 Future research

First of all, with respect to this qualitative study future research could be a quantitative study of the application of this conceptual model within schools. In this way is possible to define which is the real impact of the technology within the classroom. However, this is probably hard to realize due to the opposition of the government to this type of radical innovation. Hence it is important for future research to keep in mind the type of government in the countries. A good opportunity could be to implement this model within private

schools that are usually proper to innovation and are able to invest more in infrastructure thanks to their fewer numbers.

Second, nobody knows what the jobs of the future are going to look like. We know that people will be able to work from wherever they want, whenever they want and in the way they want. This might originate a new research focused on the design of future learning. Could it be that children do not need to go to school at all because computer will be able to teach them in a different way? Could it be that, you can find everything you want just in two minutes using the Internet? Could it be a future without education? "That's terrible. We are homo sapiens. Knowing, is what distinguishes us from apes, Mitra (2013)".

To conclude, besides the results of this study it is important to understand that we should look at learning in a different way, a product where motivation comes ahead and where learning is the product of educational self-organization. We should see at the of future's education as an environment in which learning emerges without letting it happen, the curiosity and the creativity of every kid will create a cultural change that must be sustained by the entire education community including teachers and governments.

5.5 Lesson Learned

The finding about ICT in education, sustain that there is a lot more space to implement technology in education, in fact, most of the computer used in the schools are mainly used to write reports, search on the Internet or play any games. Christensen (1997) sustain that Computer-based learning should not target the curriculum courses because it will only find the opposition of the government that are usually intimidated by changes. Conversely, good areas where the ICT should be implemented are advanced courses where teacher are not available or to grant lessons in case students may not attend school physically. McLoughin and Oliver (1999) define pedagogical roles for teaching in a technology-supported classroom as including setting joint task, rotating roles, promoting student self-management and fostering multiple perspective. All these methods, shows that these benefits depend on the ability of the school and of the teachers to integrate information technology within the school activities.

To answer then, the research question "How can we use technology in the education system?" it is necessary define the success and the performance of Computer-Based Learning. The first lesson learned is that CBL is referred to a structured environment in which computer are used for teaching purposes and not only as a marginal element of the experience as in gaming and web browsing. Computer based learning perform best as a supportive feature of the traditional system because it facilitates interest in a topic while at the same time developing information technology skills to students.

Hence, schools will have higher success and performance in terms of kid's intelligence and creativity. This inductive model is focused on adapting the new technologies to the education processes with respect to teaching and learning program and cultural change. The main characteristics that must be highlighted in order to grant the success of this model are:

- **Customization** as the possibility for every kids to learn at his own pace inside and outside the school with the availability of a personal tutor in every moment of the day. As we can confirm from the

literature ICT will help teachers to make lesson more interesting varying the ways in which they organize people in their lesson, for example using small group, larger group or solo activities. ICT also enables kids to learn how to explain things to other and encourage them to reflect on their own work for example by predicting the outcomes of the processes. In the end, pupils can access more knowledge during school time, inside and outside the classroom.

- **Transparency** as the opportunity for teachers to receive data on real time about every student progress and intervene face-to-face on the specific topic, this will help teachers to explain thing more clearly to students. The dashboard example of Khan Academy is a really valid instrument, it gives the possibility to constantly monitor the classroom progress and intervene when needed. The teacher can choose to explain the specific topic to the student or can decide to send a proficient kid to help his peer in order to create an interaction between student encouraging collaboration within the classroom.
- **Interactivity** through videos, hints, question and a community that students can use also outside the classroom. As we have seen in the existing research kids through simulation can change variables in mathematics and investigate mathematical relationship interactively. If we think about "coding", a kid will be more interested in learning variables while he is programming a little video game instead of learning variable doing maths. Because simulations help pupils to distinguish and control variables, by changing one variable at time, or more.
- **Crowdsourcing** as the possibility to create challenges and discussions within the community. Every student that does not understand video can leave comment to the video and wait for the community to answer. This create a constantly interaction within the community where student will play the role of the teacher by commenting and answering to the community's doubt. This crowdsourcing system also give the possibility to vote for the best answers, motivating students to provide the best answer and improve their ability to explain to the peers.
- **Data Mining** as tool for collecting information about the quantity and the quality of exercises made by students. As we have seen in the literature evaluating educational program is the most reasonable way to inform learners about their progress, to inform educators about their program effectiveness, to inform the public and to create a measure of accountability that can be achieved. Because of that, the higher success of Big Data in the business environment become relevant also in the education, in fact, the perspective of this model and the challenges that education system face during the year will become monitored thanks to the possibility to collect data about the single student and of the entire classroom. Consequently, it was explained that successful educational system will identify easier the kids who are not learning properly and help them with specific exercise and clarifications.

The results show a big difference between the traditional education system and the conceptual model. The different feature listed above will create a self-learning environment that will facilitate learning and in which every student will learn at his own pace always monitored by teachers.

5.6 Conclusions

The education system seems to be outdated and not in line with the needs of the society. In order to answer the first research question, *"Can we rethink our education system?"* it can be argued that most of the current education system are looking to implement a new model that will foster children's creativity and maximize human potential. As we read in the literature Reigeluth (1994) says *"we should explore change and renewal from the larger vistas of our transformed society, envision a new society and an image of education that will create that society, design a new system based on the image, and develop the system that bring the design to life"*. Schools has the responsibility to provide students a level of education that will help them to serve the society in the next century. Most of the education system fails in this delivery, mainly because the education system is mostly based on testing and not on teaching and learning. What emerges from the literature is the necessity to design a new system that is based on the participation of those who will inhabit the system, including teachers, students, schools and government. Moreover, the design must be well organized and ready to change as new reality emerges, because future generation will re-examine their values, perspective and modes of operation. In the *Design phase*, is necessary to identify core values and guiding principles to be utilized during the design process. To forge an image that will guide the design of the system. An image that is made up of and reflects the core values and ideas of the educational system's stakeholders concerning learners, the learning process and the nature of the relationship among the educational system, its community and the larger society. The idea is to expand the role of educational system to include purposes as creating lifelong learners, developing each learner to his or her capacity, maximizing human potential, and serving the needs of the community for adult education, health, recreation etc.

Christensen (2008) states that school exist to maximize human potential. Their aim is to develop skills, capabilities and shape the attitudes of students. Therefore, they must help children to think differently and encourage the development of "Lateral Thinking" De Bono, (2009). The use of ICT within the education environment gives the possibility to create an innovative conceptual model that will define a new education system based on the finding of the literature and on the computer based learning approach.

As we have seen in the empirical analysis, thanks to the computer-based learning, teachers constantly receive data and information about student's activities and progresses, this will create a different relationship between teacher and student that will not be any more as in the traditional system one-size-fits-all but will be more personal with a 1 on 1 interaction. The teacher has the possibility to introduce the lesson and then step back waiting for the children working through different topics with videos and exercise and intervene only when student have issues on the same topic. The main difference compared to the traditional education system is changing from a standardized model that is aiming at testing children to an innovative model that will mastery kid's knowledge in every single topic of the program. Another main characteristic of the inductive model, is the availability of the website in every single moment of the day, in fact, when students come back home after the school, if they did not understand the topic in class by opening the website and watch videos about the lesson, they can clarify their doubts instead of waiting to meet the teacher in the next lesson.

To conclude, the outcome of this model is the creation of a self-learning technological environment that facilitates learning and will develop future generations able to deal with the needs the society.

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Final Summary

This study is focused on technology in the education system. Regarding this concept, the world is looking for a change in the education system, an innovation that could change the way the world learns. The education system all over the world came from the British empire and it was born to meet the need of the industrialism, Mitra (2013). Every student, in fact, must be able to read, write and do operation in their mind and, at the same time, to adapt himself to the working system all around the world. In the recent years, the education system is becoming a protracted process of university entrance and is dominating our view of intelligence. Students that are talented, brilliant and creative are not valued for their worth but they are often stigmatized, our education system is becoming outdated in the sense that, due to the rapid technology evolution that the world is facing, it is the only one that is still not evolving. In particular, is not preparing the future generation to these changes.

The education system all over the world, at the moment, is reforming public education for two main reasons:

- Economic: in order to answer the following question "How do we educate our children to take their place in the economy of the 21st century?" given the fact that we cannot anticipate what the economy will look at the end of next weekend?
- Cultural: in order to answer to that question "How do we educate our children so they have a sense of cultural identity while being part of the process of Globalization?"

The problem is that the current education system is trying to meet the future by doing what they did in the past and, by following this path they are "wasting" millions of kids who do not have any interest in going to school. In the past, children that went to school believe in the fact that working hard and doing well at school, will send you to the university and then you would get a job. In the current generation is it better having a degree but, it is not a guarantee anymore for a good job. In particular, not if the road to the job marginalises what you think is important to yourselves. Robinson (2011) sustains that this model has caused chaos in many people's lives, it has been great for some but most people have not. In fact, some children have been diagnosed with ADHD (Attention Deficit Hyperactivity Disorder). Today, we are living in the most intense stimulating period where people always interact with computer, mobile phone, advertising on television and probably this is one of the main reason why children find everyday lesson at school boring. Our children are living an education model that is "anaesthetic", it means that the education system is shutting down most of their senses.

In the entire world, there is a huge percentage of dropout rate from high school. By the way, the dropout rate is just the tip of an iceberg, what it does not count are all the kids who are in school but being disengaged from it, who do not enjoy it, who do not get any real benefit from it. The main reason is that the education system it is all going in the wrong direction.

This research will show the possibility that we could go in another direction that is exactly the opposite. We need to create a model based on the "aesthetic experience" that is when all the senses are operating together.

During my thesis, I would like to provide an answer to this main research question:

- *How can we use technology in the education system?*

  And then each of the following sub-questions:
- *Can we rethink our education system?*
- *What are the existing studies about changes in the current education system?*
- *Does technology stimulate creativity through education?*
- *How will technology improve the education system?*

The second chapter of this study aim to analyse the existing research and the literature about technology in the current education system. In the Literature Review there are two different ways of implementing the education system, on one side there are researches about incremental innovation, this approach is more conservative and try to implement technology without effective changes in the education model. For example, computer inside the school are used only within a laboratory and are mainly used to write report, doing research on the internet or play some games. On the other side, researcher says that a disruptive innovation approach can lead to a new education model. In social system such as education the most important thing is design a system that is well organized and where shared perspective is needed to ensure collective and internally consistent action. In the book "Systemic Change in Education", we found five different principles on which the education system should be organize:

Participation in design of all those who will inhabit the system, and who will be served and affected by it, is a cardinal design principle. Such participation ensures that people will have genuine commitment to the emerging design and to its implementation.

Commitment to idealized design means to create the most inspiring and best possible design, one that will act as a magnet and pull toward its realization. The ideal will be out there on the horizon and continuously guide purposeful move into the future.

Design is learning, and by learning to design and engaging it, we learn as an organization and as individual. As individuals, we learn what contribution we shall make to the whole, and as an organization, we learn to re-examine continuously our collective values, perspectives, purposes, and modes of operation.

Design never ends. New realities emerge, the context in which the system is embedded change, our perspectives change, and thus the ideal will change, as we reimage it in light of emerging changes and aspirations.

Commitment of nurturing human quality. The system is design for the human activity system, in which human beings are the most valued and are to be served by the system. It is in the power of

people to guide their own evolution and the evolution of the system to grant a better future for all, and create system of education for future generation.

The introduction of ICT provides different learning opportunities and the need to design a new model of pedagogy that will promote an organic structuring of learning experiences, a communicative learning and the possibility to change the role of the teacher from group to individual learning. Innovation in the education system need to redefine creativity and intelligence that in the recent years are losing their meaning, creativity should be seen as the ability to invent something that is useful and novel and intelligence must be seen as the ability to solve problems, to generate problem to solve, to offer product or service. Many advantages emerge from the readings, both for students and teachers, and they are related to the possibility to customize every student way of learning and at the same time help teacher to help students directly avoiding as much as possible the one-size-fits-all relationship. The teachers' perceptions of ICT are based on the benefit that ICT can bring to teaching and learning, particularly in terms of pupils' outcomes. The teachers considered that ICT could make an important contribution to schools, helping the teaching and delivery of the curriculum in a number of ways:

- ICT can help teachers make the lesson more interesting;
- ICT helps teachers explain thing more clearly to learners;
- ICT can be used in most curriculum subjects;
- ICT encourages teachers to vary the ways in which they organize pupils in their lessons, for example computer partners, pairs, larger groups.

The overall conclusion from the research literature is that ICT is used effectively and has an impact on learning, where teachers are able to appreciate that interactivity and are able to create a new approach to pedagogy. Teachers need to employ proactive and responsive strategies in order to support, guide and facilitate learning. They need to monitor progress and maintain a focus on subject learning, by structuring activities carefully and providing focused tasks.

To analyse the technology in education, chapter three described the Methodology that was used to understand technology in education. In a qualitative approach, researcher tend to collect data in the site where participants experience the issue or problem under study, that is called natural setting and the researcher must interact the problem face-to-face over time. The researcher become a key instrument in the sense that they collect data themselves through examining document, observing behaviour, or interviewing participants. One of the main instrument to obtain a consistent qualitative research is the case study. In a case study, the research question is about developing an in-depth understanding about how different cases provide insight into an issue or a unique case. The role of case study method in research becomes more prominent when issues with regard to education (Gulsecen & Kubat, 2006). Even if a common criticism of case study method regards its dependency on a single case exploration making it difficult to reach a generalising conclusion (Tellis, 1997),

this study decides to go through a qualitative analysis, in the specific, analysing the Khan Academy' case study.

In particular, we have reported some existing study about Khan Academy (KA). KA is an education website most known for its collection of videos, it offers exercises, instructional videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom. It provides a variety of materials in different subjects including maths, computer programming, science, history, economics and more. Salman Khan, founder of Khan Academy, created this website with the idea of supporting schools and children during the education process. The teachers using Khan Academy have two main benefit, the first one is that now their students can enjoy the videos, they can pause, repeat at their own pace, at their own time. The second one is the unintuitive thing about technology in the classroom that removes the one-size-fits-all lecture from the classroom and encourage students to have a self-paced lecture at home. Then, going back in the classroom, you will have the situation in which students work at their own pace, the teacher walks around and peers will be able to interact with each other, in this way, teachers have used technology in order to humanize the classroom instead of testing or making lessons.

In the existing study, schools utilize KA's resources in different ways, some schools believe that it must be used as an additional practice tool that intervene only for students who had fallen behind, others thought that KA must be used as an enrichment activity for advanced students and other as a tool for monitoring student's progress. In addition to that, the use of KA depends in every school from the different access to IT infrastructure and the levels of comfort of both teachers and students in the use of technology. The results of this analysis are very interesting, in fact, students level of engagement was higher for the majority of the classroom respect to the traditional approach. The interactivity through feedbacks, hints and access to videos help student that were struggling and at the same time give them the possibility to learn new things on themselves without the help of a teacher. Teachers also got advantages thanks to the KA experience, in fact, they increase their ability to monitor student in terms of knowledge and identifying students who are proficient and who are not. Teachers also report that the use of Khan Academy positively affect student learning and understanding of the material.

In the fourth chapter, that is the Empirical Analysis, this study presents a full analysis of the Khan Academy education model, starting from the structure of the courses and analysing all the features that makes KA a different education system: interactivity, crowdsourcing, customization, availability, motivation. Before introducing this features above it was necessary to discuss the importance of Computer-Based Learning (CBL). CBL refers to the use of computer as the main instrument of the educational environment. This definition seems to refer to the use of computer in a classroom, the term must be expanded to a structured environment in which computer are used for teaching purposes. The concept is usually seen as a peripheral element of the experience, if we took for example gaming and web browsing, that is a different way of learning but is not based on the use of computer. Since its introduction there is a debate, with arguments both in support of and

against Computer Based Learning. Among the advantages of CBL there is the ability to provide quantifiable and real-time feedback for users and it also give the possibility to educators to measure the progress of the classroom and of the single student. In particular, Computer Based Learning is seen as the most efficient and effective tool to conduct distance education, because a lesson could be created to allows people to study at their own pace, either via Internet or software installed on computer.

On the other side, the sceptical argue that CBL is limited to specific subjects and is not as good as having a human teacher because computer can only answer in the way it has been programmed. Khan Academy is not only a computer-based education system, in fact, thanks to his instrument and the possibility to collect data gives the possibility to approach education in a complete different way, with personal customization of the learning, with interactivity and with the availability of personal tutor. For this research then, Khan Academy was studied and analysed.

The courses are structured mainly with short instructional videos followed by exercises/activities and at the end of each topic a mastery challenge in order to collect data and information about every users' ability. The interaction within the website is really simple for both students and teachers. Every student in his/her profile has the possibility to look at his/her progress, discussion, project and feedback received by the community. For example, in the progress page, every user can monitor progress in terms of skills, videos, activity and be able to see a focus of the lesson learned. In the skills page, you need to select the main subject in order to see your personal progress including your ability in every topic. All of them will be listed with your personal score and with suggestion if you need practice, if you are intermediate or if you have mastered that specific topic.

On the other side, teachers can register their own class online and manage the learning of their children, teachers also must let their students know that they have a free tutor available inside and outside the classroom. The coach interface is divided in more section and they mainly give the possibility to the teachers to obtain all the necessary information about the children progress and activities. Khan Academy is creating a different system of education because it really cares about data, teacher using KA are provided with as much data as possible in order to make a diagnosis of the problem and intervene directly on the exact issue that is creating trouble to the student. Teachers know what students are doing and how many time they have spent each day on exercise, videos and their main focus.

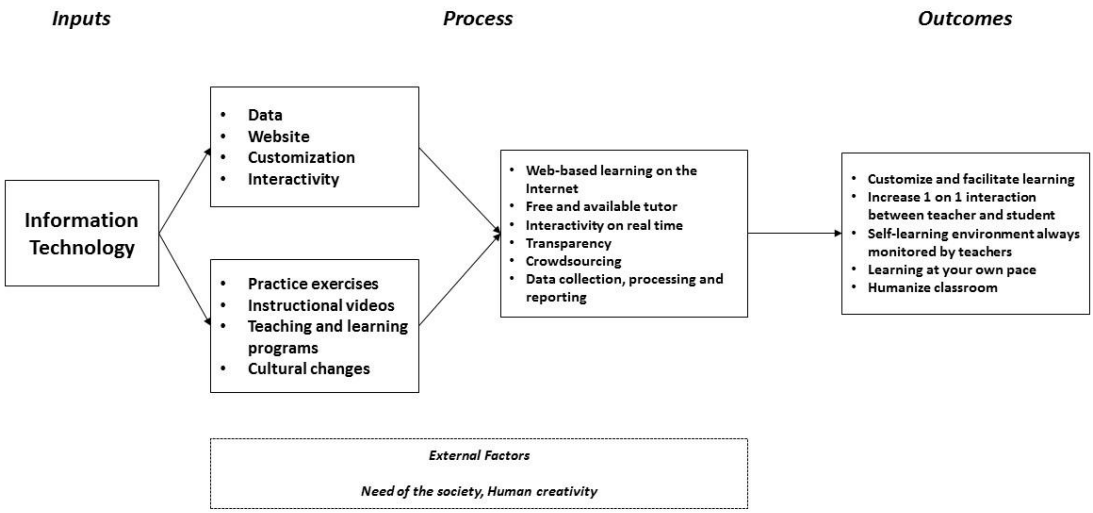
The first characteristic of Khan Academy is the possibility to be free and available to everyone, everywhere with the only limit of the Internet connection. The customization of learning is one of the most important feature of Khan Academy, students can personalize their study based on their type of intelligence and on their speed of learning. For example, students watching video tutorial can pause and repeat all the time they need to understand deeply the concept, without disturbing the rest of the class or being embarrassed for asking a "stupid" question to the teacher. On the other side, teachers can also create their own assignment and give them to their students, they can suggest to every single student specific video and activities to make them more proficient in topic that are still not clear. Another good quality of KA is the good design of the website

that is really valuable, it is really intuitive and easy to use and this encourage the children learning. Khan Academy use his website as a support feature of the education system where the teachers can register their entire class and provide exercises and video to reinforce the concept introduced in lectures. Many students using Computer Based Learning are used to enter a random answer and then going direct to the correct answer provided by the system to see the final solution. Khan Academy gives the possibility to make several attempts at solving problem rather than giving the final solution, the system motivates the student to think about the problem by giving hints and video that explain the problem that are presented in the exercise. The key feature in motivation is the opportunity to interact with the tutorial material, without fear of making mistakes.

During the empirical analysis, was necessary to create an exploratory survey conducted to determine the reaction of the users within a computer based learning environment. For example, to understand which subject they prefer to study, if they use the functions offered by Khan Academy, if they interact within the community. The main factor that motivate this research is to understand if Khan Academy' users are participating actively on the website and if they find this education system better than the traditional education model or not. This exploratory questionnaire provides very good results with a participation of 60 users from Khan Academy blogs and social network. In general, the findings of the questionnaire are that computer based learning should be implemented within the education system and is demonstrated by the high percentage of users that approved the fact. Successively, users prefer to study on their own and it is surprising that over half of users interact within the community if they do not understand a specific topic, creating an environment in which people interact between each other. In the light of the results of the questionnaire the introduction of a computer based learning platform would seem to be a good option in order to provide a radical change in the education system.

In the end of the chapter, this research presents an inductive model, that represent a new system of education that is characterized by the findings of the literature and the Khan Academy's case study. This inductive model provides a simple but extremely potent conceptual view of a project. This inductive model implies a timeline (left-to-right) where resources are made available for the work of the project, the work is executed to produce certain outputs and these outputs are then delivered to the final customer.

The input that drives this conceptual model is the Information Technology, with its primary focuses on technologies such as Web-based learning, database, customization and interactivity. These inputs must be processed and collaborate together with the teaching and learning program, cultural change and the process of data mining, processing and reporting. This inductive model consider education as a self-learning environment in which, students can learn at their own pace during the day, inside or outside schools, that constantly give information about the student's activities to the teachers.



The evidence that result from this conceptual model led to a radical change in the education model in which the education can be shifted from a one-size-fits-all approach to a self-learning environment. The features that we have mentioned before like customization, transparency, interactivity, crowdsourcing and data mining become relevant in the creation of a new education system. Thanks to the structure of the course and the interactivity provided by the conceptual model, the kids will be free to learn at their own pace the topics they like the most. The main feature that will change radically the education system is the possibility to learn at your own pace. In fact, with this model, course structure give the possibility to every student to have a personalized tutor that is available 24 hours a day, every day of the week. The traditional education system does not give the opportunity to student to learn at their speed, the lesson is standardized and they are usually based on the one-size-fits-all approach, where the teacher gives the lesson to the entire classroom without having care of students that are left behind.

The implementation of this model in the education system will grant a level of transparency between teachers-students thanks to the Dashboard that could be implemented inside every classroom. This tool will give to the teachers a real-time feedback on the single topic that every students is learning and the evolution of technology in the future will provide more accurate and reliable information about every single case. Another big advantage of the Dashboard is the possibility for the teachers to humanize the classroom, that means children that are already proficient in a topic can help their peers that are stucked on specific topic. In traditional schools this type of interaction is really rare to find, kids that are stucked are usually left behind and kids that are already proficient are bored from the topic they have already understand.

The model gives the possibility to interact to every student that does not understand the topic through videos, hints, question and answer. In fact, if they do not understand properly the lesson explained in the video, they can leave comment to the community and wait for someone to answer. This interaction system is really interesting because it also includes a voting system based on the quality of your comment that can be voted by

the community, creating a competition between students that want to interpret the role of the teacher and see their answer on the top of the list. Within the classroom this crowdsourcing system becomes really valuable and can increase the level of education inside the classroom because it creates competition between kids. The traditional system does not give the possibility to kids to have clarification outside of the classroom, in the recent years, there are some opportunity of meeting the teacher after school, but it is usually once per week.

The possibility to collect data will help teachers to receive information about the quantity and the quality of the exercises made by the student and his intention to understand the topic (Did he watch the video to understand the topic? When did he stop the video? In which exercise the children is struggling?). The collection of all this data will help teachers to find a solution in real time.

The main difference between the traditional education system and this inductive model is in the different approach to the classroom. There is a new pedagogical role for the teachers because in a technology supported classroom, educators need to promote the self-management, rotation and foster multiple perspective. This new system must expand the role of educational system to maximize the human potential and serve the needs of the community in the future.

For the current education system, this new inductive model is a disruptive innovation that the governments should be willing to accept in order to stop the dropout rate from high school and at the same time, to engage the children that goes to school but do not get any benefit from it. Technology within the education system, gives the possibility to re-think an education model introducing the opportunity to teach and learn in a different way. For what regard the learning opportunity, the development of self-learning environment *"Motivates pupils to learn independently. Continuously provides pupils with opportunities to experience learning as enjoyable and satisfying, to increase their self-motivation. Consistently provides a range of opportunities for pupils to direct their own learning; provides independent learning options, and enables pupils to access these. Encourages self and peer evaluation. Builds pupils' capacity to question themselves"*, Hay McBer (2000).

Cornu (1995), says that the development in ICT provide very different learning opportunities and a need to design a new "integrated pedagogy". This study shows the different learning opportunities granted by Khan Academy and the design that best fit the implementation of technology in education: a self-learning environment supported by the teachers.

From an economic point of view, the introduction of technology in the education system has the potential to leverage creativity, that means this new model will educate our children in line with the technological revolution that the world is facing. We must remember that, at the moment, we cannot predict the economy of the future, due to the speed of technology, because of that we should educate children in order to be able to predict the future needs, even though they are unpredictable, and to help the entire community.

From an organizational standpoint, this inductive model has the potential to re-organize the learning and teaching experience. Creating an environment in which every student can learn at their own pace,

reflecting on their doubts and activities encouraging collaborations and predicting outcomes of learning. On the other side, teachers will have the possibility to obtain data and information on real time about student and classroom progress and intervene on single children when is needed. This will result in a completely different approach between teacher and student.

In traditional classroom all over the world, the role of the teachers is to explain to the classroom in a one-size-fits-all approach, that means that the teacher will deliver the lesson and the students must follow and understand the topic. Usually you have homework, lecture, homework, lecture, and then you have an exam and it does not matter which grade every student get, the class will move on to the next topic. The idea of this system is to go forward and create a basic curriculum to all the students, but the problem is that students all of a sudden start failing because they did not understand deeply the concept. Because of that, in the recent years, most of the students are completely losing the interest in schools, some of them drop out from education while most of them are completely not interested in learning.

The model provided by Khan Academy is to mastery the knowledge in every specific subject, in fact, the exercises and the different activities encourage students to experiment and fail in order to understand deeply the topic and obtain mastery. The idea is that the teacher goes in the classroom every day and watch every kid works at his own pace, the teacher then, can monitor the students thanks to the dashboard and intervene on the kids who are not proficient or even better ask to student who are proficient in that concept to help their peer. In addition to that, the collection of data in education gives to teachers the possibility to see how many time students spend on one concept or the other.

In order to answer the main research question, "*How can we use technology in the education system?"* it can be argued that most of the current education system are looking to implement a new model that will foster children's creativity and maximize human potential. As we read in the literature Reigeluth (1994) says *"we should explore change and renewal from the larger vistas of our transformed society, envision a new society and an image of education that will create that society, design a new system based on the image, and develop the system that bring the design to life"*. Schools has the responsibility to provide students a level of education that will help them to serve the society in the next century. Most of the education system fails in this delivery, mainly because the education system is mostly based on testing and not on teaching and learning. What emerges from the literature is the necessity to design a new system that is based on the participation of those who will inhabit the system, including teachers, students, schools and government. Moreover, the design must be well organized and ready to change as new reality emerges, because future generation will re-examine their values, perspective and modes of operation. Christensen (2008) states that school exist to maximize human potential. Their aim is to develop skills, capabilities and shape the attitudes of students. Therefore, they must help children to think differently and encourage the development of "Lateral Thinking" De Bono, (2009). The use of ICT within the education environment gives the possibility to create an innovative conceptual model that will define a new education system based on the finding of the literature and on the computer based learning approach.

In the empirical analysis, thanks to the computer-based learning, teachers constantly receive data and information about student's activities and progresses, this will create a different relationship between teacher and student that will not be any more as in the traditional system one-size-fits-all but will be more personal with a 1 on 1 interaction. The teacher has the possibility to introduce the lesson and then step back waiting for the children working through different topics with videos and exercise and intervene only when student have issues on the same topic. Another main characteristic of the inductive model, is the availability of the website in every single moment of the day, in fact, when students come back home after the school, if they did not understand the topic in class by opening the website and watch videos about the lesson, they can clarify their doubts instead of waiting to meet the teacher in the next lesson.

The main difference compared to the traditional education system is changing from a standardized model that is aiming at testing children to an innovative model that will mastery kid's knowledge in every single topic of the program, that encourage creativity and increase the level of the society. To conclude, the outcome of this model is the creation of a self-learning technological environment that facilitates learning and will develop future generations able to deal with the needs the society.