Integration of Technology in Colombian Schools: Case Study of Three Schools in the Atlantico Department

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Atlantico Department

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ABSTRACT

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This study examines the experiences of teachers and students in the integration of computers in three different socioeconomic school contexts of the Atlantico department in northern region of Colombia. This research used a case study approach and collect qualitative data from interviews and observations in two public and one private schools. The analysis of teachers’ beliefs in relation to their role in education, teachers and students’ perceptions toward using technology in teaching and learning, and the uses of technology in the three schools revealed that there is no connection between teachers’ beliefs about their role in the classrooms and perceptions toward the use of technology for teaching with their actual practices. The research concludes that the development of constructivist classrooms and effective use of technology in schools is a slow evolutionary process, which requires not only a better preparation of teachers but also a change in students’ expectations.

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CHAPTER 1

Introduction

One of the current worldwide trends in education is the incorporation of new Information Communication Technologies (ICT) in school settings in order to enhance teaching and learning practices. It has been claimed that the use of technologies in schools can contribute to new teaching and learning experiences, connect schools with the real-world, promote independence for schoolwork, and provide students with the competencies necessary to perform well in today’s society (Bransford, Brown, & Cocking, 2000; Jedeskog & Nissen, 2004; Smeets, 2004).

Therefore, developed and developing countries, at their own paces, have assumed the challenge of reforming education with the integration of new technologies. In Colombia, the government is combining efforts to support this integration in public schools. The Ministry of Communication, the Ministry of Education and private corporations participate in the program Computadores para Educar [Computers for Education]. This program was launched in March 2000 with the purpose of offering access to ICT in public schools that serve students in the lower socio-economic strata\(^1\) of urban and rural areas\(^2\).

\(^1\) The Colombian socio economic stratification is a classification of households based on their physical characteristics and their surrounding into six groups or strata, which determine the level of economic resources of its inhabitants in the following way: 1= low low, 2= low, 3= middle low, 4= middle, 5= middle high, and 6= high. (Departamento Nacional de Planeación - DNP)

\(^2\) The definition of Colombia’s rural area is based on administrative criteria and is defined as the villages that are not included in the population centers officially defined as urban. One of its characteristics is that more than 50% of the economically active population dedicate themselves to primal activities and generally lack urban services. (Leibivich, Nigrinis & Ramos, 2006)
*Computadores para Educar* recycles computers that companies no longer use and that are donated to the program. These computers are refurbished and software donated by Microsoft is installed in them; afterwards, they are delivered to public schools throughout the country, free of charge (Mejía & Bernal, 2003).

In June 2007, 6743 schools in Colombia out of the 13977 public schools in the country (Ministerio de Educación, 2009) had benefited from the program. However, computers by themselves cannot do what is intended, if they are not used appropriately by teachers and students. Researchers have found that the massive introduction of ICT into the school has not had a significant impact on improving the quality of teaching and learning methods, because the use of ICT that most teachers do is merely instrumental, accompanying the traditional transmission of knowledge (Becker, 2001; Hayes, 2007; Smeets, 2004; Zakopoulos, 2005; Zhao & Frank, 2003). One of the hindering factors found for using ICT in teaching has been the lack of knowledge and skills of teachers to use them (Becker, 2001; Cuban, 2001; Tella, Tella, Toyobo, Adika & Adeyinka, 2007; Toprakçi, 2006). In order to address this barrier for the integration, the program *Computadores para Educar* provides, to each school that receives computers, training in the effective use of technology in education during the first two years.

This research is concerned with the process of technology integration in schools, particularly in the context of low-socioeconomic urban and rural schools of the Atlántico department in the Caribbean region of Colombia. I considered appropriate to study schools that were benefited by the program *Computadores para Educar* because it guarantees that the school studied has computers and teachers and students have used
computers for pedagogical purposes. Therefore, it is supposed that schools participants in this program provided an opportunity to understand the adoption and integration of technology in the context of rural and low-socioeconomic areas.

Figure 1. Map of Regions of Colombia
Originally, I proposed the study through qualitative methods, of the experience of two schools, one rural and one urban low socioeconomic strata. However, during the data collection process, initial findings and a fast saturation of data brought the question of how different the process of technology integration was for teachers and students from high or middle-income families, who attend private schools. This motivated me to include a third, private school with the intention of comparing the technology integration process in public and private schools.

In Colombia, education is organized in the following levels: (1) preschool, which lasts three years; (2) elementary, which lasts nine years and is divided into two cycles: basic primary (first to fifth grade) and basic secondary (sixth to ninth grade), and (3) high school (tenth and eleventh grades), from which the person finally graduates with a high school diploma. Formal education in elementary and high school is offered in Colombia by 25440 scholastic institutions, from which 13977 are public and 11463 are private (Ministerio de Educación Nacional, 2009). Formal education is normally regulated by the Ministerio de Educación Nacional. It provides technical assistance and political, administrative, fiscal, pedagogical and curricular regulation to territorial entities. (Ministerio de Educación Nacional, 2001) At the departamental and municipal levels, the education secretariats function as the administrators of the resources given by the national government to finance public education, they also supervise the application of the national education politics for public and private schools, keep an eye on quality and coverage of education, approve the creation and functionality of educational institutions.
and oversee the execution and implementation of educational and institutional projects developed by each institution. (Secretaría de Educación del Atlántico).

The resources destined to education represent 5.1% of the GDP (Fundación Corona, 2006), 0.7 percentage points more than the Latin American average which is 4.4% (UNESCO Institute for Statistics, 2007). The main financial source of the educational service is the national income which by constitutional disposition, is distributed among departments and municipalities. In addition, the departments and municipalities generate their own revenues to contribute to the educational sector (Sarmiento, Tovar & Alam, 2001).

On the other hand, the Colombian government relied heavily on the private school system. The private sector of education is formed by schools ruled by the Catholic Church, schools operated by other religious denominations, private ownership schools, and international schools operated by foreign organizations (Hanratty & Meditz, 1988). For the most part, private schools finance themselves with tuition money charged at the beginning of each academic calendar and the monthly payments made by the students’ parents. Add to this the fact that many private schools located in a high strata area have as a requirement that parents must donate an amount between USD $2,000.00 and USD $6,000.00 per child which the family wishes to enroll.

When it comes to coverage and educational quality, Colombia is one of the countries from the region with the highest growth. The number of enrolled students has risen, however, in 2005, 12 of every 100 children and youth of scholastic age were not studying (Fundación Corona, 2006).
Table 1.

_Gross and net enrollment ratio_

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-school Gross</th>
<th>Pre-school Net</th>
<th>Elementary Gross</th>
<th>Elementary Net</th>
<th>Junior High Gross</th>
<th>Junior High Net</th>
<th>High School Gross</th>
<th>High School Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>82%</td>
<td>69%</td>
<td>111%</td>
<td>82%</td>
<td>85%</td>
<td>57%</td>
<td>62%</td>
<td>29%</td>
</tr>
</tbody>
</table>

Source: Ministry of Education based on DANE 2005

When comparing Colombia to other countries in the region, it was found that the net enrollment ratio of Colombia in 2006 was in elementary 91.1% while the regional average was of 89.9% and junior high with 71.2% compared to 64.2% at a regional level (Sistema de Información de Tendencias Educativas en America Latina – SITEAL, 2008).

Table 2.

_Net rates of coverage in elementary and junior high per country. Year 2006_

<table>
<thead>
<tr>
<th>Country</th>
<th>Elementary Gross</th>
<th>Elementary Net</th>
<th>Junior High Gross</th>
<th>Junior High Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>94.5</td>
<td>84.4</td>
<td>91.1</td>
<td>71.2</td>
</tr>
<tr>
<td>Bolivia</td>
<td>88.2</td>
<td>69.8</td>
<td>76.4</td>
<td>55.8</td>
</tr>
<tr>
<td>Brazil</td>
<td>91.2</td>
<td>71.2</td>
<td>91.1</td>
<td>71.2</td>
</tr>
<tr>
<td>Colombia</td>
<td>95.2</td>
<td>65.3</td>
<td>91.1</td>
<td>71.2</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>90.5</td>
<td>81.8</td>
<td>91.1</td>
<td>71.2</td>
</tr>
<tr>
<td>Chile</td>
<td>89.2</td>
<td>66.4</td>
<td>90.7</td>
<td>55.8</td>
</tr>
<tr>
<td>Ecuador</td>
<td>90.7</td>
<td>70.4</td>
<td>87.6</td>
<td>36.8</td>
</tr>
<tr>
<td>El Salvador</td>
<td>89.6</td>
<td>43.1</td>
<td>84.0</td>
<td>42.0</td>
</tr>
<tr>
<td>Guatemala</td>
<td>95.1</td>
<td>70.4</td>
<td>96.6</td>
<td>71.3</td>
</tr>
<tr>
<td>Honduras</td>
<td>96.6</td>
<td>71.3</td>
<td>88.8</td>
<td>59.2</td>
</tr>
<tr>
<td>Mexico</td>
<td>96.1</td>
<td>62.4</td>
<td>88.8</td>
<td>59.2</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>93.2</td>
<td>71.1</td>
<td>93.2</td>
<td>71.1</td>
</tr>
</tbody>
</table>

Colombia has participated in various international evaluations of education quality which permit comparison of Colombian students’ performance with those of other countries. In the last regional education quality study, SERCE 2006, of UNESCO, Colombia’s score in reading qualified to be in the group of countries with scores superior to the mean. In this group, made up of the areas of language and math, are the countries of Chile, Costa Rica, México and Uruguay. In math, Colombia is part of the group of countries which did not show a significant difference with the regional average. The other two countries in this group are Brazil and Argentina. Ecuador, Guatemala, El Salvador, Nicaragua, Panama, Peru and Dominican Republic were the countries whose scores were less than the regional mean in reading and math. Only Cuba reached the highest scores and none got scores much less than the regional mean. (LLECE – Laboratorio Latinoamericano de Evaluación de la Calidad de la Educación, 2008).

Even with the educational achievements reached in the country, they are not homogenous. Inequalities exist between regions at an educational level. Between 2000 and 2005, illiteracy in youth older than 15 decreased. Having said that, 7 of every 100 Colombians do not know how to read or write. Additionally, for each illiterate person that lives in urban areas, there are three in the rural areas. This phenomenon is higher in departments such as Chocó [Pacific Region], Córdoba, Sucre and Cesar [Caribbean Region], which illiteracy rate is equal or higher than 14%; meanwhile in Bogotá it is 2% (Fundación Corona, 2006).

According to the Informe de progreso educativo de Colombia [the Educational Progress in Colombia report] (Fundación Corona, 2006), there are big differences in
school access and education quality between children who attend public and private schools. Levels of school absenteeism are higher in rural public schools, and the public schools have the lowest results in the national examination of quality of education in Colombia (IFCES). There are three private schools with high performance in the IFCES per every public school with high performance.

Since *Computadores para Educar* attempts to contribute to bridging the gap between those who have access to technology and quality education and those who do not, it was considered worthy to compare the experiences of two public schools, one rural and one urban, where children who attend come from low income families, with the experience of one private school where students are children from high or middle income families (Saenz & Saldarriaga, 2008).

The goal of this study was to have an in-depth understanding of the experience of teachers and students in the process of technology integration in the particular context of two public schools and one private school of the Atlántico department.

This document is organized into five chapters. It begins, in chapter 1, with an introduction of the research topic, the statement of the problem, outlining the aim and objectives of the study, providing the significance of the study and its delimitations. In chapter 2, a theoretical framework presents a comparison between traditional learning and constructivism learning theories and approaches and classification of the uses of technology in teaching and learning. The literature review examines the results of several studies about technology integration in schools and provides a contextual analysis of education in Colombia. Chapter 3 presents the research framework, a description of the
design of the study and methods and procedures for collecting and analyzing data.

Chapter 4 provides a description of the contextual conditions of each case study and looks at the pedagogical beliefs of teachers, perceptions of students and teachers toward using technology in teaching and learning practices, the use of computers in schools, barriers or difficulties to use them, and points out differences between case studies, particularly between the public schools and the private ones. Finally, chapter 5 contains the analysis and discussion of the data and the main conclusions and recommendations.

Statement of the Problem

Developed countries have invested on ICT with the aim of improving and updating learning and teaching practices in schools. In the United States in 2005, nearly 100 percent of public schools had computers with access to the Internet (Wells & Lewis, 2006). According to Hepp, Hinostroza, Laval & Rehbein, (2004), countries such as Canada, UK and US have achieved students-per-computer ratios below 10:1. Developing countries have tried to follow this global trend, some with more success than others. In Colombia, public policy on ICT is implemented through three programs: the Connectivity Agenda, Compartel and Computadores para Educar. These social programs attempt “to improve access to the Information Society by providing computer equipment and connectivity in schools, municipalities, hospitals, and military centers” (Alcatel, 2006, p. 5). The program Computadores para Educar is an initiative of the government to support the integration of ICT in public schools. Computadores para Educar aims to have an impact, on the one hand, on the learning process of the children, engaging them in the acquisition and construction of knowledge, and on the other, in the social development of
children from lower-socioeconomic areas, providing them the opportunities of developing the competencies required to participate in the information society. In other words, *Computadores para Educar* is part of the government’s response to the digital divide problem between rich and poor within the country (Mejía & Bernal, 2003).

However, as Tiene (2002) states, “addressing the digital divide problem in education is a huge challenge” (p. 216). The high cost of technology causes many schools in developing countries to rely on donations of used equipment that in most cases has limited functionality. Tiene (2002) also affirms that, “high quality software available comes with a significant price tag, beyond the means of many schools in the third world” (p. 216). On the same line of thinking, Siemens and Tittenberg (2009) assure that “technological innovations in bandwidth, storage, processing speed, and software directly impact education, creating new opportunities for learner-learner/educator and learner-information interactions”. Moreover, Hepp et al. (2004) point out that hardware and software industries are constantly developing new products for education, causing a “growing educational divide” (p. iv) between those who have access to the new digital resources and services and those who do not. Considering these statements, it is easy to assume that the technology integration process in public schools that rely on computers donated by companies is completely different to the process of private schools that have resources to buy more updated technology. Users of less advanced technology are likely to learn only the simplest system applications, making it more difficult for them to take advantage of the many features that are included in current technologies.
Furthermore, the integration of technology in schools implicates pedagogical practices that are more student-centered. In respect to pedagogical practices, this study starts from the assumption that there is a strong influence of culture on teachers’ pedagogical practices and beliefs, and that teachers’ culture could have deep roots in the Catholic religion. Colombia’s history reveals that education was under control of the Catholic Church for most of the twentieth century. Colombia was officially a Catholic country until a new 1991 Constitution guaranteed religious freedom. Saenz & Saldarriaga (2008) affirm that “in most part of the twentieth century, teachers were formed by Catholic orders and the educational system was based on “a strict discipline of teachers’ constant surveillance of students… on competitive practices between students intensified through a permanent system of punishments and rewards” (p. 106), and centered on the knowledge and authority of the teacher. Saenz & Saldarriaga (2008) also point out that although the Constitution of 1991 and later educational reforms based on the new constitutional principles “granted a significant degree of autonomy to schools to organize their practices” (p. 111), it is common that public schools continue teaching the Catholic religion, enshrining Catholic images and paying Catholic priests as teachers. Besides, the majority of private schools continue being run by Catholic orders. Another statement that supports the assumption above-mentioned is that “the Catholic religion appears to be one of the most important factors influencing cultural meanings in Latin-American societies and one of the biggest powers of social control” (Herrera & Pinilla, 2002, p. 310).

With this scenario, it is likely that educational dynamics rest on Catholic principles of education, which dominated a great part of the twentieth century. Therefore, the
dynamics of the Catholic educational system described by Saenz & Saldarriaga (2008) could persist in teachers’ perceptions and beliefs toward their role in teaching and learning, predominating traditional teacher-student relationships and teacher-centered environments.

Purpose of the Study

This study has the purpose of examining the process of technology integration in three schools: two public schools, one rural and one urban that have benefited from the program *Computadores para Educar* and one private school with self-financing technological resources in the capital city of the Atlántico department. This study investigates how the experience of integrating technology in teaching and learning practices has been for teachers and students in different contexts. The first objective is to uncover teachers’ beliefs in relation to their role in education and learn about teacher-student relationship. The second objective is to comprehend teachers’ views about the role of computers in teaching and learning practices and to what extent teachers and students are using computers in their school. Finally, this research intends to find out how different the experiences of a public school from the experiences of a private school regarding technology integration are.

The goal is to gain an in-depth understanding of the experiences of teachers and students in the integration of computers in their schools and adoption of a new pedagogy mediated by technology in three different socioeconomic contexts of the northern region of Colombia.
Research Questions

The main research question addressed in this study is: What are the experiences of teachers and students when integrating technology in teaching and learning practices in an urban and a rural public school that have benefited from the program *Computadores para Educar* and one private school with self-financing technological resources in the Atlántico Department in Colombia?

The sub-questions of this study are:

1. What are teachers’ beliefs in relation to their role in education?
2. What are the perceptions of teachers and students toward using technology in teaching and learning practices?
3. How are teachers and students using the computers?
4. How different are the experiences of public schools (rural and urban) from the experiences of a private school regarding technology integration?

Significance of the Study

This research is significant for the field of educational technology in Colombia because its results may provide an insight into the socio-cultural factors involved in the computer-learning environment of schools in the Atlántico department. Moreover, a better understanding of the issues related to technology integration in schools will help decision makers to fine tune public policies associated with ICT in education in the Atlántico department.

My interest in this particular department of Colombia is due to the fact that the Atlántico department and other departments of the Caribbean region of Colombia have
been at a disadvantage compared to departments in the Andean region when it comes to educational quality. These disadvantages have led to inequities in access to higher education, scholarships and work opportunities. Recommendations generated from this study can contribute in the process of improving the quality of education, particularly in public schools of the Atlántico department.

Delimitations of the Study

In order to understand the results of this research in its total dimension, it is important to consider the following delimitations:

1. This study does not intend to evaluate the program *Computadores para Educar* but understand the process of adoption and appropriation of the technology by teachers and students of lower socioeconomic schools that use computers as teaching and learning tools.

2. The case studies belong to a specific region of the country, the Atlántico Department, which is located in the northern coast of Colombia and has particular cultural values; therefore the results of this research may not be similar to the results that would be obtained in other regions of Colombia.

3. Since this is a qualitative study that uses a case study design, the data collected cannot be generalized beyond the three schools participating in the study. The results of this study can only provide suggestions about how teachers and students perceive and use technology for teaching and learning based on the experiences reported in three different schools.
CHAPTER 2
Review of the literature

*Research on technology integration in schools*

A great number of studies around the world have examined the process of technology integration in schools. In developed and developing countries researchers have investigated whether or not ICT have an effect on the learning and teaching process of children in primary, secondary and high school education. Studies that have taken place in Sweden (Jedeskog & Nissen, 2004), United Kingdom (Zakopoulos, 2005), Australia (Hayes, 2007), and Ghana (Turner, 2006) have used participant observation and semi-structured interviews for teachers and school principals to collect data about how ICT are influencing learning opportunities, how teachers and students use computers in their classrooms, the quality of ICT teaching and the changes that have occurred in the role of the teachers after the inclusion of ICT in schools. These researches have indicated that the technology is poorly used in schools; mainly supporting traditional practices of teaching and learning. In general, technology has not been meaningfully integrated in education and it is far from achieving their goal of improving the quality of teaching and learning methods. These studies also concluded that teachers are not sufficiently motivated to enhance the teaching and learning process with the ICT available in the schools.

Studies carried out in United States (Becker, 2001), Netherlands (Smeets, 2004), Turkey (Toprakçi, 2006) and Nigeria (Tella et al, 2007) have surveyed large numbers of teachers in order to determine teachers’ perceptions and practices related to ICT in
schools. In Nigeria and Turkey the researchers found that teachers have positive perceptions about using ICT in teaching, however they have not had many opportunities to do so. In the Netherlands it was found that the use of ICT by teachers is quite limited and linked to traditional approaches of learning (Smeets, 2004), and in the United States the researcher concluded that technical expertise in the use of computers, professional engagement in informal and formal leadership roles at school, the number of computers in the classroom, the way the school day is organized, the extent to which teachers feel pressured to cover large amounts of curriculum, and teacher’s philosophies are determinants in the use or lack thereof of ICT in a constructivist way (Becker, 2001).

Other factors influencing the use of ICT in schools found in literature are teachers’ access to ICT and experimentation outside of the school context and placement of computers (Trucano, 2005). According to Trucano (2005) computers in classrooms enable higher levels of usage than computers in separate laboratories. Zhao & Frank (2003) identified that pressure and support from other teachers has a moderate effect on usage and a positive attitude toward technology increases the likelihood of utilization.

A number of barriers or hindering factors are also affecting the effective integration of technology in teaching and learning. Maddux & Johnson (2005) point out that one of the problems is that schools have limited infrastructure to support the integration, especially in terms of the amount of computers and time for professional development activities or time for preparing curriculum materials. Muir-Herzig (2004) also found that teachers need time for training and developing skills, and after that, they need time to integrate technology into the curriculum activities. Trucano (2005) assured that teaching
using ICT is more time consuming; an estimate of 10% more time is needed to cover the same material covered without using technology.

Another barrier to an effective use of technology pointed out by Trucano (2005) and Hepp et al. (2004) is teachers’ lack of confidence and expertise, and fear of using technology. This increases the resistance to change existing practices. Moreover, the frequent changes of technology that demand to stay updated with the functioning of new developments, the unreliability of equipment, lack of technical support and the use of obsolete software and hardware make it difficult for teachers to integrate technology in their daily teaching activities (Cuban, Kirkpatrick, & Peck, 2001; Muir-Herzig, 2004; Zhao & Frank, 2003).

Hepp et al (2004), described experiences of ICT in education in Latin America. Part of his analysis included cases of rural schools. He stated that rural schools face additional challenges in the process of technology integration in comparison with urban schools. According to him, rural schools in Latin America generally have precarious infrastructures, low-quality electric services, and inadequate environmental conditions for hardware.

The results of a study carried out in 4 departments of the Caribbean region of Colombia in 2000 are particularly relevant for this research because they included the Atlántico Department. The sample of the study was 45 public schools. The authors found that computers in the schools were only used for computer literacy purposes; teachers who were not in the Computer Science area made low use of the computer lab, and pedagogical experiences when using computers for teaching and learning practices were
not found. The main reason reported was that the demand of the computer lab for Computer Science classes does not allow time for other uses. The authors also found that 50% of the schools of the sample had dial up Internet access, and the telephone lines were not used exclusively for Internet connection. Besides, there was no personnel hired to provide technical support to teachers, in most cases the ICT coordinator was the computer literacy teacher (Camacho, Capacho, Duarte & Iriarte, 2001).

This research attempts to contribute to the understanding of this subject by offering an updated analysis of the technology integration process in three different school context of the Atlantico department: rural public, urban public, and urban private. Besides, the analysis seeks an understanding of the connection between teachers’ pedagogical beliefs and ICT uses for teaching and learning.

Education Context in Colombia

Historical Context

With the aim to understand the current situation of education in Colombia, it is important to outline the main aspects of its history since the last century. Colombia’s twentieth century history reveals that education has been a controversial and debated topic. The government and the Church and the two traditional parties, the Conservative party and the Liberal party were at swords’ points when it came to the power over education during different periods of Colombian history because the power over education was the power of creating citizens for a type of nation.

The Constitution of 1886 established Colombia as a Catholic country. This year also started what was known as the Conservative Hegemony, a period where the
Conservative Party, very close to the Church, held power until 1930. During this period the most important educational reform was the Law of 1903. This law is considered as the Colombian educational system’s legal basis for the first half of the century, to the point where latter provisions did not change its essential structure. The Law of 1903 placed education under the Catholic doctrine and to the government, just as it had been stipulated in the 1886 Constitution (Molano & Vera, 1982). This reform established different schedules for rural and urban schools. Rural schools had a three year plan focused on religion, reading, writing, and basic math while urban schools had a six year plan which included what is previously mentioned, along with grammar, geography, history, art, music, gym, and manual work; all of which helped form prepared students ready for junior high school.

“Secondary education was divided into three modalities: normal schools for training of teachers, technical schools, and classical schools” (Saenz & Saldarriaga, 2008, p. 106). Teachers in this period were formed to be obedient to the precepts of the Catholic Church and models of Christian values (Saenz & Saldarriaga, 2008).

In 1930, the Liberals rose to power successively until 1946. During these years the Liberals sought to secularize and transform the educational system to be in concordance with the new social and economic realities triggered by industrialization, mostly through the implementation of a pedagogy founded on the European ideas of the New School or Active School (Molano & Vera, 1982). This pedagogy based its disciplinary practices on “the trust in students” (Saenz & Saldarriaga, 2008, p. 107). In terms of teaching method, the learning from a teacher and a textbook inside a classroom was replaced by “the direct
observation of natural and social phenomena” (Saenz & Saldarriaga, 2008, p. 108),
emphasizing games, field trips, “practices of cooperation among students, and social
goals inspired by John Dewey’s pedagogical ideas” (Saenz & Saldarriaga, 2008, p. 107).

Catholic orders had lost their privileges over the public educational system.
Liberals had freed the educational system from the control of the Church. However, the
Church and the Conservative Party attacked the liberal education reform describing it as
atheistic, materialistic, communist, and pragmatist. “Opposition tactics included the
deployment of priests to state schools in order to convince parents to move their children
to Catholic private schools, and the excommunication in some regions of those who
continued to send their children to state schools” (Saenz & Saldarriaga, 2008, p. 104).

In 1946 with the arrival of the Conservative Party to power started a period of
counter-reform (Saenz & Saldarriaga, 2008). Conservatives understood education as a
return to the Catholic principles. The counter-reform meant the elimination of New
School methods, the return to an authoritarian pedagogy based on obedience, strict
disciplinary practices of control of students’ behavior, and intensification of teaching the
Catholic religion (Saenz & Saldarriaga, 2008). Catholicism was considered as a
fundamental part of being Colombian, therefore, educating students to become good
citizens meant educating them to become good Christians. The conservative government
initiated a strong attack against teachers educated during the Liberal period. Teachers
who practiced the New School model were forced to become of apostolic character,
becoming messengers of the Christian doctrine. Those who did not educate according to
the religious tradition where accused of betrayal of the nation’s values and were excluded from the profession (Pinilla, 2000). This period of counter reform went on until 1957.

In the sixties and seventies a new education model was implemented, *instructional technology*. According to Guerrero (2001) this model was part of the program *Alliance for Progress* proposed by the U.S. president John F. Kennedy in 1961, with the aim of rendering economic and technical aid to Latin American countries. This aid was intended to counter the threat of the Cuban Revolution to the capitalist interests of the U.S. The *instructional technology* model imposed by the United States was based on “Frederick Winslow Taylor’s ideas about efficiency, production, time, discipline, division of work, planning, and supervision that were applied in the American industry early in the twentieth century” (p. 8) and on behaviorist theories about learning (Guerrero, 2001).

The *Instructional technology* model stuck to “the logic of planning and directing control of study plans and teaching practices by the national state” (Saenz & Saldarriaga, 2008, p. 109). Teachers followed guides and used educational material developed by experts from other countries hired by the Ministry of Education. Decisions about teaching practices were imposed in a hierarchical (top-down) and bureaucratic way. The new curriculum favored accumulation of information over formation of character and ethical principles. Repetition and transmission of knowledge had priority over critical thinking and analysis of national problems (Guerrero, 2001). Guerrero (2001) stated that the main objective of this educational model was to train students to become the labor force of the capitalist society.
Many teachers around the country rejected this model because they saw their autonomy reduced (Saenz & Saldarriaga, 2008).

In 1984, when the central government decided to apply the reform in the entire country, the resistance by teachers and academics was formalized in the Pedagogical Movement. The effectiveness of the political and intellectual resistance of the movement led to the withdrawal of the Nation’s reform (Saenz & Saldarriaga, 2008, p. 110).

In 1991 a new Constitution of Colombia proclaimed and guaranteed religious freedom, citizens’ fundamental rights including the right of education and freedom of teaching, learning and research. In 1994, the General Education Law (Law 115 of 1994), based on the new Constitution, was approved. This law signified an enormous advance in the way education was ruled in Colombia during the twentieth century. “It decentralized educational provision and granted control to local governments” (Saenz & Saldarriaga, 2008, p. 109). The Ministry of Education licenses the schools and supervises that they meet national standards and use the national curriculum, nonetheless, it is the municipality’s responsibility to offer educational service and widen the coverage, based on local planning, on the program the mayor has presented to the community and which is supervised by the Municipal Council. The municipalities are in charge of the construction, maintenance, and endowment of the official scholastic establishments and with their own resources, they can hire an administrative and teaching staff. However, the majority of teachers are hired at a departamental level with funds from the national government. (Sarmiento, Tovar & Alam, 2001).
One of the major impacts of this law for schools was the creation of the Institutional Educational Project (PEI) with the aim of granting autonomy to schools. Public and private schools gained a significant degree of autonomy to organize their practices through PEIs. Each school has to develop their own PEI with the participation of teachers, students, principals and parents. PEIs must specify the mission and objectives of the school, the pedagogical strategy, rules for teachers and students, and resources available, among other educational dynamics. Every educational institution is mandated by law to register its PEI and the changes it may incur at the Education Secretariat of its municipality or department, with the idea of having this entity followed. (Law 180/97).

Herrera & Pinilla (2002) point out that despite the fact that the Constitution of 1991 guarantees freedom of religion in Colombia, the power of the Catholic Church over education is still very high. Many private schools belong to Catholic orders and the autonomy and the freedom of teaching that schools have through the development of their own Institutional Educational Projects have caused Catholic schools to set conditions to admit students such as to present a baptismal certificate, mandatory Catholic religion classes, etc.

The General Educational Law brought other changes to schools. Professionals from any discipline could be teachers (before the teaching profession was restricted to those who studied in teacher-training programs) and education started emphasizing the development of student competences in different areas rather than the accumulation of knowledge. However, the central government established national standards that are measured through the evaluation of students’ knowledge in language, mathematics, social
and natural sciences (Saenz & Saldarriaga, 2008). Hence, most schools, in order to achieve high scores on the standardized tests, prepare students to be good test takers focusing on drill and practice. Only since 2006 have these tests started including questions that involve more high order cognitive skills such as problem solving and critical thinking (ICFES, n.d).

Another noteworthy disposition contained in the Law 115 of 1994 is that the Ministry of Education has the obligation of developing Educational Decennial Plans with the participation of teachers, academics, governors, mayors, local ministers of education, and all citizens interested in education. “The mission of the Decennial Plan is to be a navigation chart for the educational transformations needed in the country” (Cajiao, 2004, p. 44).

The first Educational Decennial Plan was carried out in 1995 during the government of President Samper, but according to Cajiao (2004) the following governments ignored the contents and orientations of the Plan. Despite of the lack of effectiveness of the first plan, a new Educational Decennial Plan was developed in 2007. More than 20.000 Colombians from different sectors of society participated, through the Internet and calling to a national telephone line, in the public debate about the course of education in Colombia until 2016. Participants expressed a great interest in the integration of ICT in schools (Plan Decenal de Educación 2006 – 2016).

The goals of the Educational Decennial Plan 2006 – 2016 related to ICT and education are:
1. Give and maintain a technological infrastructure with equality and quality criteria to all the institutions and education centers in order to support pedagogical and management processes.

2. Strengthen pedagogical processes which recognize the curricular transversality of ICT usage, housing itself on pedagogical investigation.

3. Continually renew and follow up on institutional and municipal educational projects, in order to improve the curriculum based on the following criteria: quality, equity, innovation, and relevance; all of which promotes ICT usage.

4. Transform initial and permanent development of teachers and managers in order to focus on the student as an active subject, on educational investigation and the appropriate usage of (Plan Decenal de Educación 2006 – 2016)

*ICT Integration in Education in Colombia*

Since the beginning of the 21st century, Colombia’s governments have been developing initiatives and projects to spread the use of ICT among population in order to be in tune with the global advances in ICT uses. These projects also attempt to strengthen health, educational, governmental and business sectors.

Colombia’s public policy on ICTs is implemented through three programmes: *La Agenda de Conectividad* (The Connectivity Agenda), *Compartel* and *Computadores para Educar*. *La Agenda de Conectividad* and *Compartel* were among the first strategies created in Latin America “to improve access to the Information Society by providing computer equipment and connectivity in schools, municipalities, hospitals, and military centers” (Alcatel, 2006, p. 5). *Compartel* is a social program of the Ministry of
Communications. Its objective is to provide Internet connection and telephone services to the lower socioeconomic strata and rural areas (Compartel, n.d.). In 2007 Compartel laid the plans for the expansion and replacement of wired public telephony and the enlargement of the broadband services. This project will install 39,456 new Internet hubs in the lowest socioeconomic strata and rural area; and 40,188 in small and middle-sized business companies (Ministerio de Comunicaciones, 2008).

*Computadores para Educar* is the most important project to integrate ICT in public schools. The Ministry of Communication, the Ministry of Education and private corporations participate in this program. It was launched in March 2000 with the purpose of offering access to ICT in public schools that serve students in the lower socioeconomic strata of urban and rural areas. *Computadores para Educar* recycles computers that companies no longer use and that are donated to the program. These computers are refurbished and software donated by Microsoft is installed in them; afterwards, they are delivered to public schools throughout the country, free of charge. The program provides, to each school that receives computers, training in the effective use of technology in education during the first two years (Mejía & Bernal, 2003).

The training and accompanying program is implemented through universities and with the support of the Ministry of Education. Students from different majors carry out a social practice with the program. They are trained during three weeks and then travel to a rural area in order to work with two or three schools benefited by *Computadores para Educar* during the initial phase of the program. The first year (initial phase) of the program consists of basic training about the use of computers, workshops about the
advantages of technology use for educational purposes, and an introduction to the pedagogical support provided in the second phase. In the second year (deepening phase), teachers from different curriculum areas are trained in pedagogical uses of ICT by academic specialists.

Theoretical Considerations

*Constructivist learning theories*

The effectiveness of technology integration in teaching and learning practices is based on a shift in traditional educational paradigms. The ideas which affirm that new technologies have the potential of connecting students with the real world, contribute to students’ learning independence, promote a student-centered environment and create “opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other higher-order thinking skills” (Trucano, 2005) are close linked to constructivist learning theories and pedagogical approaches such as problem-based and inquiry learning (Hmleo-Silver, Duncan & Chinn, 2007).

Constructivism is a theoretical framework that contains different perspectives. All those perspectives view learners as active constructers of their own knowledge and stress the importance of prior knowledge, skills and beliefs to interpret and negotiate meanings (Bransford, Brown & Cocking, 2000; Hayes, 2007; Wu & Tsai, 2005). Piaget, Vygotsky, and Bruner are some of the most influential researchers of this theory of learning.

Piaget’s work is considered as radical/cognitive constructivism (Liu & Mathews, 2005). He carried out an extensive research of children’s behaviors that supported his
theory on how people learn about their world (Kim, 2005). Piaget argues that knowledge cannot be directly transmitted from person to person but rather is actively constructed or discovered (Liu & Mathews, 2005). According to Piaget, knowledge constantly changes and learners are continually reorganizing and constructing knowledge (Kim, 2005). His work focuses on “the intrapersonal process of individual knowledge construction… In the process, social environment works merely as stimulus for individual cognitive conflict” (Liu & Mathews, 2005, p. 387, 388).

On the other hand, Vygotsky stresses the role of social environment in learning (Bransford et al., 2000). This perspective is known as social or realist constructivism (Liu & Mathews, 2005) and considers that learners develop thinking through their interaction with people, artifacts (books, computer tools, etc.), and specific situations (Bransford et al., 2000; Liu & Mathews, 2005). According to Kim (2005) Vygotsky thought that “social environment is important to a child's development because it can accelerate or decelerate learning” (p. 9).

Bransford et al. (2000) consider Vygotsky’s idea of a Zone of a proximal development as a powerful influence on developmental psychology. Based on Vygostky’s work in 1978 they provide the following definition of the term:

The zone of proximal development is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers. What children can do with
the assistance of others is even more indicative of their mental development than what they can do alone. (p. 81)

Kim (2005) considers the Zone of Proximal Development (ZPD) as relevant to technology integration in education since the use of computer software could foster students’ potential development in their ZPD.

Bruner is another cognition researcher who has made important contributions to constructivism, especially focused on the teaching and learning process. According to Kearsley (1994), Brunner viewed learning as an active process. Learners “transform information, construct hypotheses, and make decisions relying on a cognitive structure to do so. Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to ‘go beyond the information given’” (para. 1).

In his work, *The Process of Education*, Brunner (1960) explains the implications of the theory for instruction. He points out the importance of structure in learning, arguing that “If earlier learning is to render later learning easier, it must do so by providing a general picture in terms of which the relations between things encountered earlier and later are made as clear as possible” (p. 12). Students should start learning the basic ideas of complex topics at early ages. “The task of the instructor is to translate information to be learned into a format appropriate to the learner's current state of understanding” (Kearsley, 1994, para. 2). Brunner states that “curriculum should be developed as a spiral so that students constantly revisit basic ideas, building upon them until the student has grasped the full formal apparatus that goes with them” (Brunner, 1960, p. 13).
Moreover, Bruner (1960) suggests that teachers should create conditions that allow students to solve problems, formulate conclusions and discover principles using intuitive and analytical thinking. Finally, he writes that students should engage in learning activities motivated by their interest in the material rather than grades or rewards.

Scaffolding is an important construct of the theory. It has been defined “as the process by which a teacher or more knowledgeable peer provides assistance that enables learners to succeed in problems that would otherwise be too difficult” (Quitana et al., 2004, p. 338). Software also can scaffold learners by providing needed structure for difficult tasks (Quitana et al., 2004).

Problem-Based Learning (PBL) and Inquiry Learning (IL) are common practical approaches to the constructivist perspective. According to Hmleo-Silver et al. (2007) “these approaches clearly provide scaffolding for student learning” (p. 99).

“In PBL, students learn content, strategies, and self-directed learning skills through collaboratively solving problems, reflecting on their experiences, and engaging in self-directed inquiry” (Hmleo-Silver, et al., 2007, p. 100). According to Capon & Kuhn (2004), PBL activates a mental model that facilitates learning. PBL may produce:

1. Superior acquisition of new material (because of previously activated knowledge structures to which it can be connected).

2. Superior recall of new material (due to an increased number of retrieval paths).

3. Superior integration of new material with existing knowledge structures
(leading to restructuring and enhanced conceptual coherence). (Capon & Kuhn, 2004, p. 63)

In IL, students learn and develop reasoning skills by “the process of posing questions and investigating them with empirical data, either through direct manipulation of variables via experiments or by constructing comparisons using existing data sets” (Quitana, et al., 2004, p. 341).

PBL and IL imply collaborative learning and emphasis on real-world activities. In these tasks, the role of the teacher is to facilitate the learning process by providing “content knowledge on a just-in-time basis”. (Hmleo-Silver, et al., 2007, p. 100).

Teaching and learning environments in traditional vs. constructivist classrooms

Teachers’ philosophy is an important factor affecting the quality of technology integration (Hayes, 2007). Constructivist and traditional teaching approaches determine the use of technology in classrooms. This section outlines and contrasts the characteristics of traditional and constructivist teaching practices. This will serve as a parameter to uncover what kind of approach is consistent with the teachers’ practices observed in this study.

Traditional teaching is linked to the behaviorism theory. Behaviorism “explains learning as a system of behavioral responses to physical stimuli” (Fosnot, 1996, p. 8). Teaching practices based on this approach involve preplanning the curriculum by breaking a content area into parts that follow a hierarchy order, from simple to more complex knowledge. Practice, reinforcement, rewards and punishments are basic components of this learning approach (Fosnot, 1996).
Traditional classrooms are teacher-centered, the students learn from teacher’s explanations or from reading textbooks. In these classrooms students listen and follow teachers’ directions passively, raise their hands to answer questions and work independently allowing as few mistakes as possible. Knowledge and skills are mastered through repetition, and practice out of real-world contexts (Becker, 2001; Muir-Herzig, 2004; Ravitz, Becker & Wong, 2000). This approach promotes learning many facts by memorizing them, skill that is incompatible with the amount of new information generated in a constantly changing world. Today’s need is to produce lifelong learners who can be able to find and analyze information, think critically and solve problems strategically (Trinidad, 2003).

Kim 2005 describes five typical situations in traditional classrooms:

1. Teachers often disseminate knowledge and expect students to identify the facts of the knowledge presented.

2. Most teachers rely heavily on textbooks. Often, the information the teacher disseminates to students is directly aligned with the view of the textbook.

3. Most classrooms encourage competition among students, structurally discourage cooperation and require students to work in relative isolation on tasks that require low level thinking, rather than high-order thinking.

4. Students’ independent thought is devalued in most classrooms. When asking students questions, most teachers seek not to enable students to think through intricate issues, but to discover whether student know the “right” answer.
5. Schooling is premised on the notion that there exists a fixed world that students should understand. The construction of new knowledge is not as highly valued as the ability to demonstrate mastery of conventionally accepted knowledge. (Kim, 2005, p. 8)

In contrast, constructivist classrooms are student-centered, focused on authentic tasks with relevance and connection with real world (Becker, 2001). The interests, questions and understandings of students drive the learning process (Ravitz et al., 2000). Teachers are facilitators of an active learning and students work collaboratively (Muir-Herzig, 2004). In these classrooms “learning is a constructive process, mistakes and confusion sometimes provide the engagement that is needed for effortful learning”. (Ravitz et al., 2000, p. 3)

According to Ravitz et al. (2000), constructivist approaches demand more time and effort from teachers than merely presenting facts ordered in a sequence of contents. Moreover, teachers must have a multiplicity of skills to create learning environments that allow students to:

Identify their own issues and problems to be solved rather than having questions defined for them, decide how to explore an issue or solve a problem rather than having these procedures defined by the teacher, reflect further and makes sense of what they have experienced, and interact with peers by presenting their solutions, describing how solutions were reached, and receiving feedback (Ravitz et al, 2000, p. 4).
Besides this, Bransford, et al. (2000) argue that it is important for instructors to clearly distinguish between a theory of pedagogy and a theory of knowing. Constructivism is not a description of teaching; however, it gives applications for instruction. “A common misconception regarding constructivist theories of knowing (that existing knowledge is used to build new knowledge) is that teachers should never tell students anything directly but, instead, should always allow them to construct knowledge for themselves” (p. 11).

*The role of technology in teaching and learning*

Technologies can support both traditional and constructivist learning practices. Jonassen, Howland, Marra, & Crismond (2007), explain that teachers “have almost always” used technologies in traditional ways of teaching. Therefore, students learn information from technology “just as they learn information presented by the teacher” (p. 6).

The role of technology in traditional classrooms is to deliver lessons to students. “Too often, students are using the technology to reproduce what the teacher or textbook told them or what they copy from the Internet” (Jonassen et al., 2007, p. 6). Jonassen, et al. (2007) do not conceive the use of technologies in schools “as teachers or repositories of information” (p. 6). They affirm that “productive and meaningful uses of technology will not occur if technologies are used in traditional ways – as delivery vehicles for instructional lessons” (p. 10). According to Jonassen, et al. (2007) students should use computers to represent what they understand, to support and facilitate thinking by representing and organizing learner’s ideas, investigating and exploring, comparing
different perspectives of the same subject, simulating real-world problems, visualizing, communicating with others, discussing, and building consensus, among other high levels of thinking and reasoning activities.

Maddux and Johnson (2006) classify the uses of technologies in schools as two types: “Type I applications are those applications in education that make it easier, simpler, faster, or otherwise more convenient to continue teaching in traditional ways” (p. 3). Type I applications are basically drill-and-practice applications and teacher-centered. The role of the user is “relatively passive and what happens on the screen is largely predetermined by the programmer” (Maddux & Cummings, 1987, p. 16). Cuthell (2006) states that Type I applications support teachers by providing “feedback to the learner, error messages, prompts, templates and wizards” (p. 101). Brawner & Allen (2006) based on Maddux, et al classification, operationalized Type I applications including “Accelerated Reader and similar software, educational games on the computer, study guides, tutorials, and using a word processor for typing vocabulary words” (p. 36).

On the other hand, “Type II applications are those uses that make it possible to teach in new and better ways—ways not possible without information technology” (Maddux & Johnson, 2006, p. 3). Type II applications are user-centered; for the most part, the user controls what happens on the screen. These applications stimulate creativity and active thinking. Learning experiences are based on problem solving, collaborative working and thinking skills. The computer serves as a tool to aid cognitive process (Maddux & Cummings, 1987). Examples of Type II uses are simulations, word processing, problem-solving software, virtual experiences, online research, graphing
software, digital and video cameras, presentation software, spreadsheets, WebQuests, programming, and creation of publications such as web pages or brochures (Brawner & Allen, 2006).

Another classification of the role of technology that is widely used in literature refers to the type of thinking that it stimulates: High order and low order thinking. Lim & Tay (2003) define high order thinking as a cognitive process that requires “analyzing, evaluating, connecting, imagining, elaborating and synthesizing information” (p. 427). On the other hand, low order thinking refers to “the simple recall of facts or information retrieval” (Lim & Tay, 2003, p. 427).

These classifications and definitions will serve as the platform for the analysis and discussion of the data generated in this research. The following chapter will describe the research design.
CHAPTER 3
Methodology

*Design of Study*

This study uses a qualitative methodology in order to understand the integration of technology in selected schools in Atlantic Department in Colombia. The study is designed as a descriptive multiple case study. The case study approach allows me “to investigate a contemporary phenomenon within its real-life context” (Yin, 1994, p. 13). I chose a case study design as a research method because I wanted to cover contextual conditions in which the integration of technology occurs in the schools. Another important criterion of using a descriptive case study approach was to obtain as end product “a rich, thick description of the phenomenon under study” (Merriam, 1998, p.12).

The main question of this study is: what are the experiences of teachers and students when integrating technology in teaching and learning practices in an urban and a rural public school that have benefited from the program *Computadores para Educar* and one private school with self-financing technological resources in the Atlántico Department in Colombia? This study has four sub-questions to examine: (1) What are teachers’ beliefs in relation to their role in education? (2) What are the perceptions of teachers and students toward using technology in teaching and learning practices? (3) How are teachers and students using the computers? (4) How different are the experiences of a public school from the experiences of a private school regarding technology integration?
In order to understand the processes of ICT integration in schools, the study used qualitative methodology. This included observations of teachers and students integrating ICT in school classrooms and interviews with teachers, students and administrators.

Triangulation is commonly used in case study research (Yin, 1994; Merriam, 1998). It involves the comparison of two or more sources of information about the same topic of interest. The goal is to seek “convergence of meaning from more than one direction” and avoid the biases of using only one method (Lindlof & Taylor, 2002, p. 240). This study triangulates the data collected from multiple sources to understand the uses of ICT in schools from various perspectives and enhance the qualitative validity of the study.

Sample

The first step was to choose schools from the list of those that had benefited from the program Computadores para Educar because these schools have computers available to teachers and students, and have used them for pedagogical purposes.

Two schools were selected from the list on the Computadores para Educar website based on the following criteria: (1) geographical location, (2) years in which schools received the computers, (3) number of computers received, and (4) willingness to participate in the study. At the moment of the selection the list had 6743 schools that had were benefited from the program in the entire country from the first semester of 2001 to the first semester of 2007. The first criterion, geographical location, was used to select schools of the Atlantico Department and to get a list of rural and urban schools. The results were 218 schools in the Atlantico Department, 97 urban and 121 rural schools.
The second criterion was schools that were benefited by the program between the years 2003 and 2005. These years were selected because in 2003 *Computadores para Educar* started to implement an improved training program for the schools that receive the computers, and 2005 because this assures that the schools already completed the training program. The third criterion for selection was schools that have received more than 20 computers. Thirty-three urban schools and 25 rural schools met the abovementioned criteria. Three schools were selected from each short list in a random sample to send invitations to participate. The schools selected were the first rural school and the first urban school that express its willingness to participate in the study.

The third school was selected drawing upon a convenience purposive sample (Merriam, 1998) based on the need of studying a private school where students come from high or middle-income families. The school was selected because it met the criteria and it was relatively easy to negotiate access due to personal contacts. I did not have any previous knowledge about the technology availability of this school.

Each case study was built with the participation of teachers, students of different grade levels and subject matters, school principals and direct observations of classes.

*Brief description of case studies*

*Case 1: Rural Public School.* This school is in the municipality of Galapa, one of the 23 municipalities of the Atlántico department. It is located 16 km east from Barranquilla, capital of the Department. Galapa has an estimated population of 30,000 with an area of 98 Km². Its main economical activities are agriculture, cattle raising and handicraft.
This governmental school has two buildings in different parts of the municipality. One is a small building for students from kindergarten to third grade and acceleration. Acceleration is a grade for students that have been out of the school system. The purpose is to level out those students with their peers of the same age in order to incorporate them to the regular system and avoid having older students with younger ones in the same grade. This facility has three aisles for classrooms, a small administrative office, one computer lab and a small schoolyard with cafeteria. The second building has students from fourth grade to eleventh grade. This is the main facility. It is a large building with ten aisles for classrooms and one for administrative office and staff room. It also has a library, an auditorium, a dining hall, two computer labs, other laboratories, a big schoolyard and a cafeteria. The school has two schedules (forenoon and afternoon). At the time of the study, there were about 4000 students with an average class size of 34 students. There were 132 teachers and 7 members of the support staff.

Case 2: Urban Public School. This is a small governmental school located in Barranquilla, capital of the Atlántico Department. Barranquilla is the major commercial and industrial center of the Colombian Caribbean region and it is the fourth largest city of Colombia with an estimated population of 1,148,000. The school is located in a middle low socioeconomic strata neighborhood of Barranquilla, although, most students come from different neighborhoods of lower socioeconomic strata.

The school has a small facility with 12 classrooms, an administrative office with a teachers’ room, and a computer lab. It has one small schoolyard with a tent where students can buy snacks. There are about 800 students registered from kindergarten to
eleven grade in two school schedules (forenoon and afternoon) and the average class size is about 25 students.

*Case 3: Urban Private School.* This is a Catholic school located in a high socioeconomic strata neighborhood in Barranquilla, as are many of the private schools in the city. The school belongs to the Order of Saint Augustine. It has a big facility with a sports coliseum with two swimming pools, basketball, soccer, micro soccer, volleyball and tennis courts with seats for 2000 spectators. It also has a chess room, a music room with many musical instruments, an extensive library, two well equipped computer labs, a big chapel that also function as an auditorium, a teachers' lounge, a pedagogical materials and services room for teachers and students, a conference room capable of accommodating 270 people, a dinning hall and a cafeteria. There are 1100 students and 75 teachers from Kindergarten to eleven grade. The average class size is 28 students.

In the findings chapter, other relevant aspects of the context of each school will be described and discussed.

*Data collection procedure*

The data was collected during one month from July 28 to August 28, 2008. I spent 8 days in each school and collected data through semi-structured interviews and observation of classes where the students used technology for learning.

*Interviews*

The interviews were conducted with teachers, students and school principals. The interviews with teachers were considered the main source of information of each case study. These interviews allowed me to understand the integration of technology from
teachers’ perspective. The teachers were interviewed for approximately 45 minutes each. A total of 22 teachers were interviewed face to face, distributed in the following way: 8 teachers from the public rural school, 6 from the public urban school, and 8 from the private school.

The interviews with students were conducted mainly to know their perceptions about the use of computers in teaching and learning practices in their schools. These interviews were 5 to 10 minutes each. A total of 30 students were interviewed.

The interviews with the school principal of each school had the purpose of understanding the context of the school. The principals provided information about the type of students who attend the school, the position of the school in relation to the city, town or neighborhood, the process of getting the technology available in the school, and other specific issues in relation to students, teachers, and technology. These interviews were approximately 60 minutes long. School principals were the gatekeepers of each school. They introduced me to the teachers in charge of the computer lab and in turn they refer to teachers of different subject matters that use the computer lab with their students, and some of these teachers refer to others as a snowball sampling.

The interviews were semi-structured. Open questions were followed up on the interviewee’s responses in a conversational manner to capture teachers’ and students’ own meanings. Teachers’ interviews were structured around 5 topics: background information about the teacher, pedagogy strategies and beliefs, perceptions of technology for teaching and learning, uses of computers in their classes, and difficulties or barriers they have faced to integrate computers in their classes. The interviews were digitally
recorded with the exception of two, one with the principal of the private school and one with a teacher in the urban public school who agreed to be interviewed but not recorded. In these cases I took notes of the interview.

Observation

There are different roles or degrees of participation for a researcher who observe a scene: complete participant, participant-as-observer, observer-as-participant, and complete observer (Lindlof & Taylor, 2002). In this study the observation of the classes was conducted from the role of observer-as-participant. In this role the researcher is not part of the scene, he or she participates primarily as observer but with the possibility of casually interacting with the participants to clarify some aspects observed, in order to avoid misunderstandings (Lindlof & Taylor, 2002). I observed classes where the students use technology for learning from one point of the classroom where I could observe all the students and the teacher. From that point I took notes without interfering in the classroom environment. The observation was carried out to compare what the teachers said and what they did and to understand the learning environment.

The observations were focused on the classroom context, technology available, type of activity, nature of the student activity (passive and receiving or producing and creating), interactions of students with computers, classmates and teacher, methods of teaching and learning (teacher-centered or student-centered), the role of the computer, and student’s objective and goals in the observed sessions. Sixteen classes were observed in different subject areas: Computer Studies, English, Social Studies, and Science. All of them were conducted in computer labs.
Ethics

Before starting the data collection procedure the research proposal was submitted for approval of the Institutional Review Board. This research qualified for exempt review according to IRB guidelines:

“Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods (IRB guidelines, Appendix A Exempt Categories)”.

Prior to the interviews and observation participants’ informed consent was obtained. I explained that the purpose of the study was to examine the experiences of teachers and students using computers for teaching and learning in schools and ensured that participants understood that: (1) participation in this research was voluntary. It is not part of their job or school duties and it does not have effect on their job or any employment or school evaluations; (2) they will not be identified by name and their responses will be maintained confidential, (3) the interview will be recorded to help me to accurately report the conversation, however, if the participant prefers not to be recorded, I will only take notes during the interview; (4) they know who to contact if they have doubts or further questions about the study; and (5) that they have the right to not answer questions they do not want to respond or cease the interview at any time.
Data analysis procedure

The data was analyzed in two stages. First, interviews and observations were analyzed separately, and second, the data collected by different methods were compared and discussed.

In order to analyze the interviews the transcriptions were read several times and the answers were open-coded, 49 codes were grouped in 9 categories and subsequently were grouped in 4 themes that responded the research questions. The following table shows the established categories, the codes that form each category and the final themes.

Table 3.

<table>
<thead>
<tr>
<th>Categories, codes and themes</th>
<th>Codes</th>
<th>Themes</th>
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<tbody>
<tr>
<td><strong>Context</strong></td>
<td>School social environment</td>
<td>Understanding the context</td>
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<tr>
<td></td>
<td>Students socioeconomic strata</td>
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<td></td>
<td>Technology acquisition</td>
<td></td>
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<td></td>
<td>Technology available</td>
<td></td>
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<tr>
<td>Teachers’ background</td>
<td>Grades and courses taught</td>
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<td></td>
<td>Time teaching</td>
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<td></td>
<td>Training</td>
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<tr>
<td>Beliefs about teachers role</td>
<td>Teacher as a facilitator of knowledge construction</td>
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<td></td>
<td>Motivator</td>
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<td>Authority</td>
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<td></td>
<td>Life guide</td>
<td></td>
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<tr>
<td>Changes in teaching and learning environments</td>
<td>Students motivation</td>
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<td></td>
<td>Pedagogical changes</td>
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<td>Teachers’ perceptions of the role of computers in schools</td>
<td>Collaborative learning</td>
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<td>Research tool</td>
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<td>Computer literacy</td>
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<td></td>
<td>Preparation for the life after school</td>
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<td></td>
<td>Make things easier</td>
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<tr>
<td>Perceptions of teachers toward using technology in teaching and learning practices</td>
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<tr>
<td>Advantages</td>
<td>Disadvantages</td>
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<td>------------------------------------------------</td>
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<tr>
<td>• Students’ educational outcomes of using technology in classrooms</td>
<td>• More responsibilities for teachers</td>
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<tr>
<td>• Get out of the rut</td>
<td>• Students wants to play or search other topics</td>
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<td>• Students have fun</td>
<td>• Several versions of a topic</td>
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<tr>
<td>• Keeping the students on task</td>
<td>• Students gets lazy (copy and paste)</td>
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<td>• Class participation</td>
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<tr>
<td>• Increasing knowledge</td>
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<tr>
<td>• Understanding abstract concepts</td>
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<td>• Active role in learning</td>
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<tr>
<td>• Active role in learning</td>
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<tr>
<td>• Grasp the material better</td>
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<tr>
<th>Pedagogical Uses of computers</th>
<th>Uses of computers</th>
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<td>• Complement and reinforce topics</td>
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<td>• Drill and practice</td>
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<td>• Blackboard substitute</td>
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<td>• Visualization</td>
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<td>• Research tool</td>
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<td>• Textbook substitute</td>
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<td>• Creative activities</td>
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<tr>
<td>• Modeling and simulation</td>
<td></td>
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<tr>
<td>• Types of software and hardware used in their teaching activities</td>
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<td>• Frequency of use</td>
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<tr>
<th>Barriers</th>
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<tr>
<td>• Technical problems</td>
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<td>• Lack of technical support</td>
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<td>• Number of computers per students</td>
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<td>• Slow and obsolete computers</td>
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<td>• Lack of relevant software</td>
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<td>• Access to computer lab</td>
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<td>• Time constraint</td>
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<td>• Lack of training</td>
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The notes from the observations were analyzed taking into account the categories and themes identified in the interviews. Overall, the research process allowed me to obtain a deep understanding of a complex process with so many particularities that it is not possible to generalize the integration of technology process within the context of each school. The next chapter provides a description of the findings including the contextual conditions of each case study, the pedagogical beliefs of teachers, perceptions of students and teacher toward using technology in teaching and learning practices, the use of computers in schools, barriers or difficulties to using them, and differences between case studies.
CHAPTER 4

Findings

The findings are organized around the following themes: (1) Understanding the context, (2) teachers’ beliefs about teaching and learning practices, (3) perceptions of teachers and students toward using technology in teaching and learning practices, (4) teachers and students’ uses of computers, and (5) differences between the experiences of the two public schools and the private school regarding technology integration. The themes contain information collected from interviews with teachers, principals, students, and observations in the three schools selected for this study.

Understanding the context

Social and educational environment

The rural public school is a large school located in the heart of the municipality of Galapa. It has about 4000 students distributed in two buildings. Based on the interview with the principal of the school, many of its students come from villages that surround the main town, where technology is not available at all. All students belong to the lowest socioeconomic strata, 1 or 2.

The principal gave a general profile of the students from fourth to eleventh grade. She stated that most of students lack interest in learning and they do not like writing or reading. She also said that it is very difficult for teachers to engage them in the learning activities. They like to play percussion instruments, sports, and computer literacy classes. The teacher of computer literacy reinforced the principal’s statement when she said:
They like the computer literacy classes, to work Office tools and they handle them with skill, easily producing PowerPoint presentations, spreadsheets and typing documents utilizing the tools Word offers them adequately, but when they are asked to produce a document where they must use their descriptive and narrative abilities, they hit a roadblock, be it because they are lazy, or their lack of interest or because they do not think they can complete the assignment. (High School Teacher, Rural Public School)

The principal also stated that there are several problems in the school related to students’ violent behavior. She explained:

Violence in the school mirrors family problems. They are also tired of the routine because in this municipality there is scarcely any cultural or recreational activities that can be attended. All this is expressed as a lack of leadership, low self-esteem, aggressive behaviours, low academic performance and apathy in class. (Principal, Rural Public School)

During the period of data collection in this school, two cases of students taken to the principal’s office due to criminal activity were observed. The first case had to do with two students who deceived another to steal her cell phone, and the second was a fight between two students who possessed cutting weapons.

On the other hand, the Urban Public school is a small school with approximately 400 students in each school schedule. The school is located in a middle low socioeconomic strata neighborhood of Barranquilla, although, according to the principal
of school, most of students come from strata 1 and 2 and very few students live close to
the school in strata 3.

The principal reported that for the most part, students come from dysfunctional
families. Some are witnesses and victims of domestic violence, some do not live with
their mothers or do not have someone to take care of them because their parents work all
day and spend all the time outside school by themselves. According to the principal the
family problems of the students affect their behavior in the school. She stated:

…when students arrive to the school, they show to be strongly aggressive, and
since no one pays heed to them at home, they do things here to call for attention.
For example yesterday there was a case where a student brought paint thinner,
which is quite strong and threw it at a peer’s eye; fortunately it didn’t penetrate the
actual eye, but it did burn the eye area, so one called the mother but since she works
as a maid, she said her boss didn’t grant her leave, so we had to suspend the child
until he could show up with a responsible adult. (Principal, Urban Public School)

The principal also said that verbal violence is very common. Students offend each
other insulting and denigrating their mothers. According to her, the problems are more
common with 6th, 7th and 8th graders. Elementary and high school students are much
more quiet and peaceful.

The urban private school is a Catholic school located in a high socioeconomic
stratum neighborhood of the city. In an interview with the principal, he reported that there
are 1100 students in the institution and approximately 20% of the students come from
strata 6, 45% strata 5 and 35% strata 4.
Priests of the Order of Saint Augustine run the school; therefore, Catholic values are a very important part of the students’ education. In this school, unlike the two public schools, there are no cases of aggressive or delinquent behavior. The principal and the discipline monitor of the school only occasionally have to deal with minor behavioral problems.

Most of teachers are young people, including the principal who is a 35 year old priest. He believes in the constructivist pedagogical model and is fostering a change in the school. He explained it in the following way:

We have been going through the process of changing our pedagogical model for a couple of years now, we are trying to focus on a more practical application of what is learned instead of just relying on memorization. This is a process which requires time in order to develop, mature and achieve the students’ affinity to the school, for them to fall in love with learning. (Principal, Private School)

According to the principal, approximately 90% of students have computers and Internet at home and they mostly learn about the basic use of computers at home and they learn about specific software uses in the computer science classes.

Overview of technology conditions

The rural public school has one computer lab in the facility for K-3 students and two labs in the main facility. The computer lab in the K-3 section has 20 computers but only 15 were working at time of the data collection. These computers were donated by Computadores para Educar in the first semester of 2006. They have Windows 95 and Windows 98 operating systems and some are equipped with pedagogical software for
elementary levels. These computes are obsolete and work extremely slow. Students waste a lot of time waiting for them to turn on and open software. They are supposed to have Internet connection, however during the week of the data collection none of them could get connected to the Internet.

Even though, *Computadores para Educar* offers free repairs during the first two years after computers are received, they have opted for finding alternative ways to fix the computers for several reasons. First, they have to send the computers to Bogotá and the first time they sent two computers, it took more than 3 months to have them back; and second, the computers breakdown all the time, so it is not worth it. The maintenance of these computers is carried out by the son of the K-3 Computer Science teacher, who is a computer technician, when he has time to go to the school and fix computers for free as a favor for his mother. Besides this occasional volunteer, they do not have technical support in order to resolve problems with the computers.

A similar situation happens in one of the computer labs in the main facility of the school. The lab has 15 computers, donated by *Computadores para Educar*, that are used for English classes, however, according to the teacher, she has never seen the 15 computers all working in unison, there are at least one or two that are always damaged. She explained the situation of this computer lab in the following way:

We have many difficulties when it comes to using this room, as you saw, you could easily lose an hour of class because you end up having to help each student enter the program since they do not know how, the seventh graders do not know how, the ninth graders can do it on their own. Not to mention that the computers are very
slow, sometimes the whole hour is wasted, I can spend an entire hour trying to get on a webpage with these computers. Because of this, even though this is the English classroom, I use the computers as long as the weather permits me to, for example, today it is sunny, I can try to go online, but when it is cloudy out, there is no internet access, the signal is weak, besides these computers are too old. I have found some programs in order to work with the students but the computers’ memories can’t handle them, so I go online and look for activities there. (Junior High Teacher, Rural Public School)

The third computer lab is more updated than the other two. It has 17 computers with the operating system Windows XP. All of them were working and were able to access the Internet. There is a video projector but it had broken-down. These computers were purchased through an agreement with institutes of higher education and a private company. The maintenance of these computers is financed with the school’s own resources. This computer lab is used by seventh to eleventh graders. Students in fourth, fifth and sixth grade do not use computers at all. They have computer literacy classes in their schedule, but these classes are theoretical. Students learn about computers from a blackboard, textbooks and by drawing computer parts in their notebook. As a teacher of stated: “It is like learning how to ride a bicycle by only drawing it in a notebook”.

This can be seen as a setback in their process of becoming proficient in the use of computers. The Computer Studies teacher stated that many seven graders come to the class without knowing how to use a mouse. However, it should be noted that current
seventh graders did not have access to computers before in school because computers for K-3 had only two years of being in the school at the time of the study.

This school does not have computers located in classrooms; however, some attempts to integrate technology in subject areas were found in K-3 and high school (from grade nine to grade eleven) where some teachers reported having taken students to the computer lab for integrated classes³.

The urban public school has one computer lab with 20 computers and a dot matrix printer donated by Computadores para Educar in June 2006. The computers are equipped with the Windows 98 operating system and pedagogical software. Technical problems are very common in this lab. At the time of the study 10 of the 20 computers were out of order. The following account of the Computer Science teacher illustrates the situation:

… It is common for me that things like the computer won’t work or the mouse is damaged, for me that is common, it is part of my job’s routine, it has to be a miracle for me to walk into the room and have the twenty computers working, it would be strange. Sometimes the students are working and halfway through the class a computer breaks down so I end up having to group students in order to complete the assignment. But that is part of the dynamic that the students and I understand as well, so no one here gets upset when they need to change computers because they know that it is normal, because we cannot repair it immediately

³ Integrated classes is the way teachers refer to classes where students use computers for learning in subject areas different to Computer Studies
because I can’t interrupt the class in order to repair a computer (Computer Science Teacher, Urban Public School).

The maintenance of the equipment is carried out by the Computer Science teacher and a group of eleven graders that the teacher has taught how the computers work internally, to repair and clean them, and to install software. This training is part of a project based on the Educational Law 115, which decrees that it is an obligation for tenth and eleventh graders to render social services in order to graduate high school. According to the law, students in tenth and eleven grade should work in activities related to teaching literacy, health promotion, environmental education or education for citizenship. This decree inspired the Computer Science teacher to develop a proposal to have eleventh graders working in computer literacy. In order to do that, students attended Saturday classes and currently, they assist the teacher with his classes for elementary students, helping other teachers that use the computer lab with technical problems when they arise, and helping the teacher in charge of the lab to fix broken-down computers. This was an initiative of the Computer Science teacher that attempted to solve a problem of his lack of time due to the many responsibilities he has in the school. He is the Computer Science teacher in every grade and in the two school schedules, he was the only person in charge of computer maintenance and in addition he is the Natural Science and Chemistry teacher in tenth and eleventh grade.

One of the main functions of students in this project was to help teachers of other subject areas in their integrated classes. However, the Computer Science teacher stated that in general, teachers do not ask to use the lab; they do only in very few occasions.
None of the classrooms in this school had computers; therefore all the pedagogical activities that involve the use of computers are carried out in the computer lab.

The private school has two computer labs; one for elementary students and the other for secondary students. Each computer lab is equipped with 30 computers with flat screen monitors and one video projector. All computers are connected to the teacher’s computer and he is able to monitor what students are doing in their computers, block or allow their use, and show all or some of them what he or a classmate is doing in the computer. The teacher’s computer is also linked to the video projector.

Both labs have Internet connections, computers work with the operating system Windows Vista. They have installed, besides the complete Microsoft Office package, Corel Draw, Photoshop, Flash and interactive and 3D software such as Google Earth and Visible Body. They also are equipped with maintenance and restoration software, used in public access computers, called Deep Freeze. This means that students can feel free to make any changes in the configuration, for instance the cursor appearance or they may download and install new software, etc. However, every time the computer is restarted, all changes are wiped clean, and the computers’ configured baseline setting is restored.

There are no computers in the classrooms; therefore, teachers who want to use computers for their classes have to take the students to the computer lab. In this case, the Computer Science teacher works as a technology assistant facilitating subject-area teacher work and resolving any technical problem that might arise during the class.

The number of computers in the labs is enough so that there is one student per computer. At the time of the study all the computers were in good condition and working
fast. Teachers have the possibility of saving the classes in the computer lab. This is an advantage for students that are absent or have special needs, for instance students that are not able to take notes and pay attention to the class at the same time. Students can save the lesson in a flash drive or the teacher can send it to the students’ personal emails.

**Teacher training**

The computer literacy teacher of the elementary section of the rural public school has a Bachelors Degree in Spanish. She is in charge of the computer lab and the computer literacy class after the two year training provided to several teachers in the school by *Computadores para Educar*. Another teacher who received the *Computadores para Educar* training in computers stated that all the teachers trained by *Computadores para Educar* are capable of using computers and doing well in the development of integrated classes. However, another teacher trained by the program said that the time of the training was not enough to learn about the use of computers and software. In her opinion, they needed more training in order to do well with computers. The computer literacy teacher affirmed that several teachers of the school attended a course offered by a university in Barranquilla where they learned how to create blogs and insert music, and videos on it, but they have not been able to apply what they learned with their students because the computers they have in school cannot support these kind of activities.

The computer literacy teacher of 7th to 11th graders of the public rural school has a technical training in Microsoft Office Software and at the time of the study she was undertaking a course for Corel Draw, Adobe Photoshop, Adobe Acrobat and Adobe Flash. She was also trained in a Normal School, schools for the training of teachers.
The computer literacy teacher of the urban public school has a bachelor’s degree in Science. He affirmed that he has never studied computers but he learned by himself through a trial and error method. Now he teaches 11th graders how to fix and maintain computers. He also received the training offered by the *Computadores para Educar* Program, training, that according to this teacher, 12 teachers of the school started but only 4 teachers continued until the end.

The computer literacy teacher of the elementary grades of the private school is a Computer Science engineer with pedagogical education in a Normal School and the teacher of the secondary and high school students is a college senior student in electronic engineering with no pedagogical training. Other teachers of this school, such as the elementary Natural Science teacher and the high school mathematics teachers have been trained in the use of technology in education in short courses offered by a university in Barranquilla.

*What are teachers’ beliefs about teaching and learning practices?*

According to Becker (2001) the type of software and the way teachers use it are determined to a great extent by teachers’ beliefs about teaching and learning. Teachers in this study were asked about their role in the classrooms as a starting point to analyze their methods of teaching and reveal their teaching philosophy. Almost every teacher talked about teachers’ role from a constructivist perspective. Some of the most common answers were that teachers’ role is to help students to construct knowledge, guide processes of learning, and prepare students with real life skills. The following quotes exemplify their answers:
The teacher is the guide of a learning process; he should look for ways to have the students develop their capacities, the teacher is secondary in the classroom. The student understands better when the teacher puts himself at the students’ level. (Mathematics and Geometry teacher, Urban Public School)

Some teachers answered comparing their role when they started to teach and their current role:

Before, education was more traditional, the teacher was always right, and whatever the teacher said was what was important, but not anymore, education now helps the student build his own knowledge based on experiences and lived situations. A teacher can no longer say this is A, or that is that. Now the teacher’s role is very important because she has to help the students construct their knowledge on their own, or make them compare different points of view and reach a consensus. (Primary Education Teacher, Rural Public School)

Another teacher stated:

When I began to work, one was the dictator, one had the knowledge, one decided what was to be learned; now the kids have the knowledge and one has the responsibility to somehow develop their skills, order their ideas. (English Teacher, Rural Public School)

However, there were traditional views that to some extent contradict, within the same discourse, the constructivist approaches to teaching and learning that teachers claim. A teacher from the private school who made explicit their constructivist approach, stated that authority is part of the role of the teacher in a classroom. The word authority
seems to be more linked to a traditional approach of teaching, and even contradictory to
the constructivist approach, since authority brings up the idea of a vertical relationship
between teacher and student; where the right to give orders, make decisions and exercise
control over students is held by the teacher. Another meaning of authority that also
contradict the constructivist approach is an expert whose views are taken as definitive.
The same teacher expressed it in the following way:

  I consider that the teacher should be an adviser, a proactive human element who
  establishes an action activity along with the student. In other words, coordinate the
  activities that are proposed in the classroom from the perspective of the
  pedagogical model that we follow in the institution, in this case the model which
  we base ourselves on and we feel comfortable with is constructivism; therefore, in
  my opinion, the teacher should work along with the student so that a cooperative
  learning process can take place but above all, the teacher must maintain a respectful
  attitude and an authoritative role so that said activities may have a happy ending.
  (Natural Science Teacher, Private School)

Another teacher from the private school mentioned authority and patience as
important characteristics of being a teacher. She said:

  More than an authority, authority is a characteristic, but it is not what being a
teacher is all about; if you do not have this characteristic, it can be said that the
teaching and learning process cannot be completed. But that authority accompanied
by a mutual respect, with patience, because many teenagers nowadays require lots
of patience. The teacher’s role is also that of a guide throughout the students’ life
projects. As a guide, he/she must have authority as a characteristic, but also be instructive, motivating, because if the student is not motivated, there cannot be an adequate learning process. (Spanish Teacher, Private School)

Teachers were also asked about how ICT is changing teaching and learning environments. Their answers were classified in two prominent topics: (1) students’ motivation and (2) teaching pedagogy.

Students’ motivation

Motivation and increasing attendance were the most common answer of the teachers of the public schools. Teachers from these schools indicated that most students had their first contact with a computer in the school. This is especially true in the rural public school. They reported that students love to go to the computer lab, students ask for their computer classes all the time, and when they are in the lab they do not want to leave to another classroom. One respondent said that: “for the students, computer class is the synonym of joyful class and nice class” (Social Science Teacher, Urban Public School). He also pointed out that computers have motivated students to research topics on their own. For teachers it is also a motivation to provide access to computers. As one of the teachers stated:

In this school, we only worked with primers, chalk and boards. We desired to have computers because we knew that as soon as we had them the experience was going to be much more productive, it was going to change in such a way not just for one as a teacher but for the student as well because it is so new; the fact that they had a computer was so motivating for them as it was for me; there are very poor children
here and one gets motivated when one can see that they can access the things that technology is currently offering us, it is very satisfying. And we will keep fighting and we will keep working; right now we have been having problems with the internet, it has been damaged, but our goal is to surpass these obstacles, giving them [the students] the same opportunities as anyone else...because they come from very vulnerable places. (First Grade Teacher, Public Rural School)

Some teachers from the private school also affirmed that the use of computers motivate student learning. However, the reasons were completely different. While students in public schools feel motivated because the school is for the most part the only place where they can access computers, teachers of private schools argued that students like classes with computers because they are in their natural environment. One teacher explained it in the following way: “They were born into the technological revolution and I think that whatever is visual, the audio and the interactive activities are fundamental in the way that they achieve to learn” (Social Science Teacher, Private School).

According to the teachers of the private school, almost all students have computers and Internet at home and in general students are very proficient in computers. Some teachers stated that they are constantly learning about computers from students.

**Teaching pedagogy**

Teachers from the rural public school placed significant importance on technology as an agent of change in their school. Despite the deficient availability and condition of computers in this school, most respondents stated that computers have brought huge changes in the learning environment. For instance, teachers mentioned: classes are more
interactive, students lead their own learning, students research and expand their knowledge, and teachers changed billboards for hi-tech didactic aids. To quote one of the respondents:

The change has been very good, it has been great, let’s say it has been a huge change, which has definitely taken us from the blackboard over there and the desks where they sit, to have the student investigate what he or she is learning and one is only there to orient about the use of tools since the rest is being obtained by the student. Now here you can see that they are working with a special natural science program and they put together puzzles and from that very activity they are obtaining knowledge of for example body parts, the parts of the head, the digestive system, the respiratory system and ultimately it is a huge evolution from only working on the blackboard and arriving here with a computer, that is where I see the change, very beneficial, very advanced. (Elementary Teacher, Rural Public School)

Similar responses were found in the urban public school. Teachers pointed out that before the introduction of technology in schools, students’ learning was based on memorization and now students have more information and develop strategies to understand what they are learning and connecting it with their lives outside school. However, one teacher gave a very different answer. He stated that nothing has changed with the introduction of computers in schools. As the following extract from the interview illustrates:
We are still the same, nothing has changed, the only thing is that we are using a new tool, like when the calculator was introduced, the problem sheet stepped aside a bit. The computer is another tool; the thing is that it helps making your didactic strategies diverse… I can have a very bad class using computers and I have had very lousy classes when using computers, and you can also have a very good class also using computers, it depends of the usage and the skill you might have to use them. The pedagogical model has to be clear in your mind. This means that the computer is not going to change your pedagogical model; you can’t stop thinking that you are going to teach science this way because you now have a computer, you are going to take the computer and use it as a development tool for your activities and the development of your pedagogical model, of your work method, of the class’ methodology, that is what you are going to do, for example, if you are still an old fashioned teacher, the computer is not going to change your mental paradigm… You think that because you taught a class using a PowerPoint you have done a great thing, you just traded paper for a PowerPoint presentation, but you have not done a great thing. (High School Teacher, Public Urban School)

Teachers of the private school pointed out the following changes: before, teachers based their teaching practices on textbooks and blackboards, now teachers are required to know about and use computers, software and Internet. Before, students’ learning context consisted of textbooks and blackboards, now students spread information and exchange ideas through blogs or websites. And before students could not disagree or object with
what the teacher had said, now students’ previous knowledge and views are encouraged and taken into account.

During observations of classes in the computer labs, I registered aspects related to methods of teaching and learning, types of activities, and interactions of students with teachers. These notes revealed that, in most cases, class methodology is teacher-centered. Teachers give step-by-step instructions that students follow word for word on their computers. The knowledge construction process that teachers mention is most of the time made through the use of low-order thinking software that have predetermined activities and provide feedback to students in a way of error or right messages. These types of activities support traditional ways of learning and keep students in a passive role within their learning process. The following extract from the observation notes is an illustration:

The Computer Studies teacher of the Urban Public School delivers a lesson about using Excel to high school students. The teacher asks students to access Excel while he starts drawing a Excel sheet on the blackboard and filling it with names, numbers and other data.

Teacher: You guys should write this database exactly like mine, meaning if the name I write here is in Caps Lock, yours should be the same way in your computer, if I write something in red, you should also write it in red.

The teacher writes a name entirely in lower case.

Student: Teacher, names always start with a capital letter.

Teacher: That doesn’t matter; you should write it exactly like I wrote it.

(Observation notes, Urban Public School)
Another example was an integrated class in the public rural school for students of acceleration classes. The topic was the digestive system. Before the class started, the teacher told me that the objective of the class was that students construct their knowledge about the digestive system with the help of the software ECO-Ciencias.

Teacher: Today we are going to work on the digestive system and we are going to use the ECO-Ciencias software. I am going to walk by your seats and help you open the software, those who already know how to open it can proceed. None of the students could open the program on their own. The teacher went to each one of the computers but only 4 of the 15 working computers could access the program. The teacher asked the students to work in groups of five students per computer. Once the program opened in the computer and they had selected the digestive system, you can see a drawing of the human body with no animation effects with the parts of the digestive system in their correct place. The student must observe the image and where each part is located within the system. Having finished that, the students must press F5 in order to change the place of the parts in random order. Then, with the help of the mouse re-order them. The students receive a score based on the amount of organs they can place in their correct order. While the students finished the activity, the teacher tried to maintain the discipline of students that were going from group to group comparing scores.

The teacher got close to the observer and commented, “with these tools we are giving them autonomy in their learning process, in the search of their understanding, because in a classroom you can show a picture and that is it, but the
innovation of using a computer that they can touch and for them to construct their own concept, because here in the lab no one is going to tell them where each part goes.” (Observation notes, Rural Public School)

The class described was based on a type I application. The activity consisted of memorizing the place of organs within a system and the reward consisted of obtaining a high score. However, the excitement of students was evident since they entered the computer lab. They enjoyed the activity and repeated it until they got the best score; it was clear that for them this activity was more a computer game than a class. It would be worth it to find out if this kind of motivation and emotion could result in a longer lasting knowledge about the topic.

Summary

Teachers’ beliefs about teaching and learning practices were mostly expressed from constructivist perspectives. Most teachers believe that their role is to be a helper of the students’ knowledge construction process. However, marks were found in their discourse which indicated that they have not completely abandoned traditional views of teaching.

Teachers linked the use of computers with constructivist approaches of teaching and learning and attributed the use of ICT in classroom activities with the capability of promoting students responsibility for their own learning, preparation for the working world, and the connection of learning with real-world problems. However, these perceptions about the role of computers in learning are not connected with the practice. Some teachers overestimated the role of computers in learning because they seem to believe that sitting a student in front of a computer is enough to promote student learning.
One of them proudly described a low level of thinking and reasoning activity that student carried out with the computers in her class and considered it as a knowledge construction process.

Only one teacher believed that computers do not change teaching practices and uses depend on teaching pedagogy. He stated that computers can accompany traditional or constructivist pedagogical practices. The statement of this teacher was supported by the observations of classes, which show that teachers’ methods are mostly teacher-centered and students play passive roles in their learning.

*What are the perceptions of teachers and students toward using technology in teaching and learning practices?*

**Teachers’ perceptions**

Every single teacher interviewed showed positive perceptions toward using technology in schools. They considered technology important and beneficial for students and teachers. Nevertheless, some teachers also expressed what they considered are the disadvantages or inconveniences of using technology.

Among the positive aspects, teachers from the two public schools highlighted the importance that students acquire skills in the use of computers for their performance in a future workplace. Another repeated view point, especially in the rural school, was that computers change the class routine, make classes funnier and students engage easier and for longer time in the learning activities. Teachers of the urban public school emphasized the importance of computers as tools that allow students to broaden their knowledge.
They also pointed out that computers facilitate teachers’ work. One teacher gave the following example:

…it is easier to prepare fifteen PowerPoint slides than to prepare fifteen display boards with paper and having to draw. In PowerPoint you can insert photos and do a whole number of things like hyperlinks and hypertexts. What I mean is that you can do different things as opposed to what you could do with a display board and it is more attractive to the students. (High School Teacher, Public Urban School)

Different teachers from the private school pointed out that the use of interactive software, such as Google Earth to learn topics related to geography, or geometric software that allow students to understand abstract concepts and their utility in the real-world are beneficial because they lead students to develop their own conclusions, fix the knowledge, and motivate students’ interest about the subject of study.

On the other hand, several teachers mentioned aspects of using technology in schools that they consider as disadvantages. The most common aspects mentioned were: first, students spend the time set for class activities on the computer in other things such as visiting websites not related to the topic or in text based communication through Messenger or chat rooms. Second, students become lazy about their schoolwork because they copy and paste what they find in the Internet, most often in Wikipedia, and present it as an assignment done, sometimes without reading it.

Some teachers, especially from the private school, expressed discomfort with aspects of using technology in school that revealed that they prefer to maintain traditional (teacher-centered) approaches of teaching. One of the teachers pointed out as a
disadvantage that the use of Internet is causing students to get information that represents a different point of view from what the teacher is teaching and this generates a lot of discussion in class. The following account from the teacher of the private school confirms this:

One of the disadvantages is that there is certain information that the student may bring from the Internet which generates a discrepancy from what the teacher may say. Even though sometimes one is at advantage because we can demonstrate… There is subjectivity in the social sciences, there are different theories so maybe the student can say: but I read so and such on the internet, and thus a mix-up occurs because the student doesn’t know who to believe, who do you believe; the teacher, the internet, the peer who brought the information? So one can fall into that routine if one does not revise the material that students are going to look up on the internet. I try so these things do not occur, so when I have the students investigate from the internet, I give them exact websites where they can obtain information because if they depend on Google, that is where the problem starts, then we have to convince them, after something like this occurs, we have to bring examples and things that support what we are is true and that there is information that is not always reliable. So this is one of the disadvantages that I see. Another thing I see is that the initial purpose changes route, they want to start seeing different pages and one has to be there in order to guide them towards the original goal I had established. (High School Teacher, Private school)
Several teachers expressed points of view regarding the use of computer by the student. These points of view support the idea that learning is something that students have to do in a serious and boring way and it is not something to enjoy. Two teachers of the private school stated that students do not know how to use computers in a productive and correct way because they use them for entertainment activities. The following extracts from the interviews are indicative of this:

(1) A teenager today aged of 14, 15, 18 does not have a clear vision of what MSN is really, they do not see it as a means of communication in order to send data and maybe to communicate with people that do not find themselves in the same place that they are in, the real usage which should be awarded to MSN, but we see the student today: Oh yes, I am going to chat with a peer, and they start exchanging information that is not healthy for them, but while we use this technology, we will utilize it to transmit data about computers, technology, social sciences, taking into account the geographical aspect; we will transmit and share knowledge through MSN as a means of communication through its chat interface, that is the use and importance we should give it as a whole, so we do not see it as other places where MSN is just a way to chat, but as a means of communication which is useful for me in order to share knowledge (Junior High Teacher, Private School).

(2) Students need to be oriented so they know how to chat, because they think chatting is cool, that they are talking with other people, but they need to be guided so they make good use of the technology and that they not only use it to have fun but to study as well. (Elementary School Teacher, Private School).
Students’ perceptions

Although students reported none or few experiences using computers in other classes apart from computer literacy, many students stated that computers make classes more dynamic and less boring. They also affirmed that they understand and learn better from classes in the computer lab than in the classroom. One of the most repeated reasons was that teachers show the topics visually.

Only one student of the rural public school expressed a different opinion. He said:

One learns more when the teacher is up front, writing because with the computers you only learn how to use the keyboard, the mouse, the printer while when the teacher is dictating, one understands more (Seventh-grader, rural public school).

Students who reported that occasionally they have been in the computer lab with teachers of other areas such as: Spanish, Social Sciences, Natural Sciences and English, had difficulties remembering something that they learned in those classes. They were asked to tell something they had learned in the classes that they said they had used computers. All of them answered that they did not remember. For instance, one of them mentioned that in his Spanish class, he searched the Internet for the biography of an author of a book but he did not remember the name of the author or the book.

An interesting contrast is how students from public schools stated that they like everything about computers; while students from the private school, even though they do not experience technical problems in their school, stated that they do not like when a computer works slowly or freezes.
Summary

Teachers have positive and negative perceptions about the use of ICT in education. However they perceive that there are more benefits than harms. Most teachers perceive that computers are important in order to prepare students for a future work environment and facilitate students’ learning. Among the disadvantages, two were related to students’ uses of computers. First, teachers mentioned that students prefer playing games or visiting other websites during the class time in the computer lab and second, students copy and paste information from Wikipedia and turn it in as an assignment done. Other disadvantages pointed out by the teachers are related to their traditional views of teaching, making them consider normal and even desirable situations in constructivist learning environments as disadvantages, such as students’ expression of different points of view.

Although the integration of computers in learning areas different to computer studies is minimal, most students perceive that they learn more in class where they use technology. However, none of them was able to remember something specific as to what they had learned.

How are teachers and students using the computers?

Pedagogical uses

The findings revealed that the use of computers for areas apart from computer literacy is not very common. Most of the students stated that they only go to the computer lab when they have computer literacy classes. However, several teachers of different areas of study and different grade levels in the three schools affirmed that they have used
technology for teaching. Teachers’ reports about technology integration in their classes were classified in 5 ways: (1) Drill and practice, (2) Blackboard substitute, (3) Visualization tool, (4) Research tool, (5) Textbook substitute, (6) Creative activities, (7) Modeling and Simulation, and (8) Computer literacy.

Most teachers considered computers complement and reinforce what the students are learning in the classroom. However, differences in the way of developing activities that complement classroom learning were found among the three schools. Drill and practice uses are the most common activities to complement and reinforce learning for elementary school teachers of the public rural school. The only way that these teachers integrate technology in their classes is using the software donated by Computadores para Educar. Most of these software are designed to support drill and practice in Natural Sciences, Geography, Spanish and Mathematics. The activities are predetermined and there are a limited number of exercises. Thus, as one of the teachers commented: “after two or three times that a student has executed the exercise, he knows by heart how to solve it”.

One teacher explained the methodology of integrated classes in the following way: I work in integrated classes. We are practically covering theory in the classroom and putting it to work in the computer lab. I bring the group to the lab after I have given some sort of lecture on the topic and when we arrive I explain how to access the software that we will be using. That is usually the routine we use when we come here. The programs are already designed for these types of activities, for example, a Natural Sciences class about the circulatory system; the theory is
given in the classroom and when one arrives to the computer lab we can develop the material in a more practical way because the program is already designed and shows every part of the circulatory system” (Elementary School Teacher, Public Rural School)

These attempts to integrate technology in teaching of different subjects are limited by the topics contained in the software donated by *Computadores para Educar*. The Computer Studies teacher, who is in charge of the computer lab, stated that only a few teachers use the computers in their classes and on a few occasions during the school year. According to this teacher the different software contain only few topics and as a consequence, most of the classes are being taught in the classrooms. Another reason she mentioned is that many teachers do not feel comfortable enough to use computers and help students with technical problems. She also reported that the first year after the implementation of the *Computadores para Educar* program in the school, several teachers brought students to the computer lab to work integrated classes, but in the last year she is the only person who uses the lab for computer literacy classes. She did affirm though that in several occasions she lets students use the software to practice on topics of other subject areas, especially, the Spanish software, which contains exercises about antonyms and synonyms, because her bachelor’s degree is in Spanish.

Drill and practice software are also the only application used by English teachers in the three schools. They use the CD-ROM that textbooks brought with exercises or found websites where students can fill blank spaces with the correct word or match vocabulary with drawings, etc, and get a score.
Some high school teachers of the rural public school and the private school reported the use of Power Point presentations as an instrument to teach their classes. From their statements it was clear that teachers use them in two ways: as a blackboard substitute and as a visualization tool. One of them stated that when possible she uses slides instead of blackboards because according to her the use of Power Point presentations motivate students and enrich the learning environment. Another teacher reported using Power Point to show illustrations that enhance students’ understanding of topics and engage them.

The use of computers as a visualization tool was also reported by two teachers of the private school who take students to the computer lab to search the Internet for illustrations or videos about the topic. Another teacher of the private school stated that he works conceptual maps with high school students to show relationships among concepts, an activity that implies high order thinking.

Mathematics teachers of the urban public and private school have carried out other exemplary practices of using computers as a visualization tool in order to allow a better understanding and grasping of concepts. However, it should be noted that these initiatives come from personal motivations and have been executed with resources that do not belong to the school and they are not part of the regular development of curriculum. In the case of the urban public school, the high school mathematic teacher is undertaking a Masters in Education with emphasis in Mathematics. She has learned in the Masters the use of educational software and wanted to use it with her students. They had to rent a public Internet access center to carry out the class because the computers they have in the
school cannot support the software. Each student had to pay the equivalent of 50 cents USD in pesos in order to access the computers. The teacher explained the situation in the following way:

I have the Cabri Geometry software in my USB drive, so with the ninth grade students we rented a Cyber Café nearby and installed the software in each computer and I explained the activities that can be completed with the software. But before taking them to the Cyber Café to work on the software, they had seen the topic in the classroom, the old-fashioned way. For them the computer activity was a lot more fun. Students do not like mathematics much, so it was fun and innovative to sit at computers because they didn’t know it was possible to solve math problems using a software. Their performance was much higher compared to when they completed the assignment with a pencil and a paper in the classroom, there was better understanding. The children were a lot more motivated, when they began to work on their own, they finished in less than five minutes and then they wanted to participate, everyone had the answer and they wanted to explain the procedures, while when they were in the traditional classroom, it was like pulling teeth, no one wants to step up to the blackboard and in the lab was completely different. The students liked the class a lot and they asked when I was going to repeat the activity, but that implied a cost for them and you know that the school is of a lower socio economic level, and not every student is able to pay one thousand pesos for an hour of internet” (High School teacher, Urban Public School).
Similarly, the Mathematics teacher of the private school worked with 7º and 8º grades students with graphic calculators she borrowed for three months from a university project she was participating in. She also reported obtaining outstanding results in the learning process; although she had only 3 graphic calculators for 27 students when ideally each student should have one. She affirmed that:

It was amazing, the conceptual understanding they got using the graphic calculator. Students of 8º grade figured out concepts that they study in 9º grade. Now they are studying those concepts: sine, cosine… and the 9º grade teacher told me: Hey, I feel it has gotten easier because it seems you talked about sine and cosine functions in 8th grade. They even began to interpret and connect what they were learning to things of their daily life, for example one boy said it was like when my mom got an electrocardiogram (ECG)… They were fascinated; the students which are currently in eighth and had the chance to see them when they were in seventh ask me, ma’am, when are you going to bring the calculators? (Junior High Teacher, Private School)

Another use of computers mentioned by teachers was a research tool. Several teachers take their students to the computer lab to search in Encarta, Wikipedia or Google more information about the topic of the class or ask students to search information at home and bring it to the class. One teacher of the private school stated that after students researched about global warming there was a discussion in class about different hypotheses on the topic. He also said that students got some information from Facebook or YouTube.
In the public urban school, two teachers reported that they have used computers to replace textbooks. One of them explained:

Due to the fact that the children who attend this school are from lower socio economic strata, many have economic inconveniences when it comes to buying the textbooks; so many times finding a website that they can use is much more convenient. They are told to go to such search engine, look for this name, when you find it make a summary. Some teachers want something in physical, so they look for it and print it. (Junior High Teacher, Urban Public School)

Other teachers have experimented with more creative and high order thinking uses of the computer. These practices were found in the urban public school and the private school. One teacher of the private rural school reported that he had his students working with Microsoft Publisher to produce tourism brochures of different African countries. The purpose of this activity was to learn about African geography and practice computer skills in a creative way.

Two teachers of the urban public school reported the use of modeling and simulation software. The Social Science and Economics teacher of high school students stated that he worked with an engineer professor of Universidad Industrial de Santander programming simulation software to recreate economic and industrial activity in Barranquilla. Many real and hypothetical variables were introduced in order to obtain different graphics. Students analyzed the graphics and drew a conclusion about the type of situation generated after the introduction of the particular variable. This teacher also
said that the variables introduced corresponded to students’ questions reflecting their own interest in the topic.

The Science teacher of high school students, who is also the computer and technology teacher of all grades in the school, has also experimented with modeling and simulation software in his classes. He has worked in modeling the process of oral hygiene for first and second graders and has used it in the computer studies classes. He created a representation of a denture and the process of brushing teeth, the effect of the toothpaste, and dental problems such as dental caries and tooth decay.

For his eleventh grade students, he developed a simulation to explain a complex topic: population ecology. He assured that the simulation helps students understand the calculation of changes in population demographic and analyze and interpret the results.

This teacher pointed out that preparation of these classes takes a lot of time. He said:

For me it is more complicated to integrate technology into the classes because I create my own activities. I am not a consumer of activities developed by others, when you go to use software that comes with the activities already designed, the class is extremely easy because you bring the software someone lent you or that you bought or downloaded, you use it and that is it, much easier. But when you make your own resources it takes much more time, although you end up building up your own collection of work material. Simulation use takes time but is very satisfactory when you work with children, it is worth it.
All the uses above mentioned are part of the attempts to integrate technology in the teaching of subject areas, and although from teachers’ reports it is possible to believe that there are many efforts of technology integration in learning and teaching practices, these efforts are not common uses of computers in school, rather they are extraordinary activities. The most common use of computers in the three schools studied was computer literacy classes. As mentioned in the introduction of this section, many of the students interviewed stated that they only go to the computer lab for computer literacy classes.

Each school has its own computer literacy curriculum. In the public schools students in elementary grades learn about computer parts, the use of mouse and keyboards, how to turn on and shut down a computer, minimize, maximize, and basic use of Microsoft Word. The computer literacy teacher of the elementary public rural school stated that first and second graders do not turn on the computers by themselves, only third graders do. She also said that she has taught students about the rules of the computer lab such as: enter in line to the lab, do no eat in the lab, be quiet, etc.

I observed a computer literacy class for second graders in the rural public school. The following account about the class activity is part of the observation notes:

The students get in line before entering the classroom and the teacher makes them proceed in an orderly fashion, assigning two or three students to a computer. When everyone is sitting, the teacher passes by each computer to help the students turn it on. She then instructs them to open Microsoft Word and to draw the toolbars in their notebooks. The children draw while the teacher walks around the room
supervising the assignment; when the students finish drawing, the teacher lets them leave the classroom.

In this public rural school, students from 4th to 6th grade learn about theoretical aspects of computers because they do not have access to the computer labs. In seventh grade, they acquire basic knowledge about computers, and in eighth to eleventh grade they learn Microsoft Office software, specifically, Word, Excel, and Power Point. According to the high school computer literacy teacher, tenth and eleventh graders have good skills in those programs.

In the private school, students in first and second grade learn the basic tools and uses of Microsoft Word, Power Point, and Excel. In third grade they learn advanced uses of these programs, edition of images and Microsoft Publisher. In sixth, seventh and eighth grade students learn Microsoft Access, Adobe Flash, Adobe Photoshop, and animation in 3D. In ninth and tenth grade they learn graphic and web design programs, and finally in eleventh grade they learn basic electronics.

From observations of a computer literacy class for third graders, it was possible to confirm that students have advanced knowledge in the use of Power Point. In the class, they designed their own slide template and after that they created a slide with animated pictures, texts and sounds.

*Barriers to using computers*

Teachers mentioned several factors that affect their use of technology for teaching. Obsolete technology is the main barrier for the rural public school, especially for elementary students to eighth graders. The computer labs available have computers
donated by *Computadores para Educar* program, which are out of date. Some teachers reported that they have software for their classes or learned how to use a blog for pedagogical purposes but the computers cannot support the software or surf the World Wide Web. Another barrier is that there are always computers that are out of order. Broken-down computers stay in the same state for several months because the school does not have the money to repair them. Besides, the computers available are not enough and students should work in groups from two to four and sometimes five students per computer. This situation means that several students do not have the chance of using the computer in a class.

All these conditions generate frustration for some teachers. One of them expressed it in the following way:

Sometimes I am saddened to see that they are motivated to work, for example a girl who was going to write but the computer kept freezing or like others that wanted to work but the computer did not turn on, so I feel sorry because they want to work and I end up having to move them to work in groups of 3 or 4 to a computer and this does not permit for each student to work and I feel impotent because I see that each one wants to have their own computer (Elementary teacher, Rural Public School).

The barriers reported for teachers of the urban public school are very similar: obsolete computers, limited access to the Internet, and lack of pedagogical software for the classes. One teacher complained about the software provided by *Computadores para Educar*. She said:
In reality the software offered by *Computadores para Educar* are deficient. They do not let you expand the learning process. I think it does not take them to another level because they are very limited. They contribute to motivate the students in their desire to learn, but there isn’t any information that they will not find in the classroom. That is the limitation I am talking about, that software is very limited and technology offers the possibility of getting a wider scope that will really help them develop their learning processes” (Elementary teacher, Urban Public School).

Some teachers stated that computers are too slow and they waste a lot of time trying to access a program or develop an activity in the computers. The English teacher of this school said that she does not use the computers because each of her classes lasts one hour and if she includes the time she spends taking students to the computer lab, turning on computers, accessing the software and explaining the activity, the hour ends and that would be to waste students’ time for the class. One of the teachers who has worked with simulation software stated that he needs to invest a lot time in order to develop the material and the many responsibilities he has in the school is the main barrier for him.

In the private school, the main barrier reported by teachers was schedule conflicts in the computer lab. According to some teachers they use computers for teaching few times a year because it is difficult to find available hours to access with students to the computer lab. However, during the week I was in the school, the computer lab was used only for computer literacy classes and remained empty for several hours per day. One teacher of this school pointed out that a barrier for her was lack of knowledge in the use of certain software.
Summary

Teachers’ reports showed that in the three schools there have been some attempts to integrate technology in teaching and learning of subject areas. Collectively, they reported low and high order thinking uses. Low order use include activities based on drill and practice software, typing their names or transcribing texts in Microsoft Word, Power Point presentations that are used as a blackboard substitute, and retrieving information from Internet that the teacher has chosen as the textbook’s substitute. Whereas high order uses are made up of visualization tool, research tool, development of conceptual maps to show relationships among concepts, creating and producing activities, and modeling and simulation software.

However, the data collected showed that these efforts are scarce and the main use of computers in these schools is computer literacy classes. Students achieve different levels of computer proficiency according to the school, with the students of the private school the most prepared for advance uses of technology.

The main barriers for teachers in the public schools are linked to the poor conditions of technology in schools while what prevents the use of computers in the private school is schedule conflicts with the main use of the lab, computer literacy classes, or in other terms the lack of computers in the classrooms.
How different are the experiences of a public school from the experiences of a private school regarding technology integration?

All the themes analyzed above point out differences between the public schools and the private school regarding technology integration. However, the purpose of this section is to highlight the main differences.

The main differences are related to technology infrastructure. In regards to teachers’ beliefs about the role of the teacher and their perceptions toward using technology in teaching practices, no significant differences were found.

It should be noted that among the three schools studied, the school with the worst technological resources was the urban public school and the school with the best resources was the urban private school. However, in both schools teachers who have had experiences using computers for high order thinking activities were found.

Most of the computers found in the public schools are obsolete. This not only makes technology integration in subject areas difficult; it also impedes the proper training of students with the computer skills necessary for today’s workplace. On the other hand, the equipment used in the private school has more updated software and hardware and facilitates the preparation of students with a wide range of advanced computer skills. As one of the teachers stated:

The use of computers in the public schools is a fallacy; we say that students are learning how to use technology, look they have the equipment there and it turns out that it has very little memory capacity, it is obsolete, those screens are not the ones that are being used nowadays, it is as if you had completed a secretary course with
a typewriter and then you are given a computer, you realize they are completely different. So that is what happens, we are given computers that are not similar to the ones in use in this day and age and when the students enter the workforce, their skills are not contemporary. A young man from a public institution, who goes out to the job market, and is compared to one from a private institution with many more resources and has invested itself more thoroughly in the implementation of pedagogical elements for learning, will be in a serious disadvantage (High School teacher, Urban Public School).

In general, the equipment used in the private school is capable of supporting software and Internet applications that computers in the public school cannot. The software used in private school is more dynamic and interactive. While students in the public schools see flat and static images of human anatomy or maps of the globe, students in the private school use applications such as Google Earth and visible body, a 3-D, fully interactive human body that includes 3-D models of over 1,700 anatomical structures (Visible Body Web site).

The curriculum of computer literacy classes is more advanced than the curriculum of the public schools. The skills of the fifth graders of the private school in the use of software can be compared to the skills of eleventh graders of the public schools.

Besides, students in private schools have more opportunities to have hands on the computers because the ratio of students per computer is 1 to 1 while in the public schools 2 to 5 students work on one computer.
Finally, computer literacy teachers in the private school are professionally trained in the use of computers while teachers in the public schools do not have formal education on computers, most of them have learned about computers by themselves or in short and free computer training courses.
CHAPTER 5
Discussion and Recommendations

This chapter discusses the findings of the three case studies and connects them with the literature reviewed and the theoretical consideration that framed this research. It also provides recommendations for practice and suggestions for further research.

Before starting the discussion of the findings, it is important to bring up some theoretical considerations. As previously mentioned, the introduction of technology in schools embeds constructivism; and a constructivist discourse implies that students have an active role in their learning process and that teachers should create the conditions for students to solve problems, think analytically and make their own conclusions, as Brunner (1960) suggested. Constructivist classrooms have been characterized as student-centered. As Ravitz et al. understand, this means that the interest, questions and understanding of students drive the learning process. However, only certain uses of technology can help this process by stimulating creativity, facilitating organization and comparison of ideas about the same subject, and making possible to investigate, explore, argue, and other high order thinking activities. Maddux & Johnson (2006) classified these uses as Type II applications.

With these considerations in mind, the main finding of this study is that there is no connection between teachers’ beliefs about their role in the classrooms and perceptions toward the use of technology for teaching with their actual practices. All of the teachers interviewed see themselves as practitioners of constructivist and student-centered approaches of teaching. They all manage a constructivist discourse about learning which
they base themselves on in order to assure that the teacher’s role in the classroom should be that of a facilitator of students’ knowledge construction process. Besides, all of them have positive perceptions about the use of technology for education. Some common perceptions are: computers make classes more interactive and students more active in their learning process, computers connect students with real world problems and computers are important to prepare students for the job market.

Several authors have argued that teachers’ philosophy is determinant in the way teachers use technology (Becker, 2001; Hayes, 2007, Zhong & Shen, 2002). However, the teachers' beliefs and perceptions contradicted both in the practice and the discourse in and of itself. Teachers who in their discourse claimed to follow constructivist approaches of teaching also revealed points of view based on traditional approaches. The same thing happened in their discourse about the role of technology in teaching and learning. Teachers who expressed that the use of computers in classrooms have brought huge changes in the learning environment by modifying the teacher’s role and making students lead their own learning attributed this to uses of computers classified by Maddux & Johnson (2006) as type I applications. This means applications that support traditional teacher-centered practices of teaching. It is helpful to keep in mind though, that Jonasen et al. (2007) highlighted “productive and meaningful uses of technology will not occur if technologies are used in traditional ways” (p. 10).

Some teachers considered that computers made their job easier and faster, this is something that confirms that they are using type I applications, because what has been observed in other studies is that constructivist approaches demand more work (Ravitz, et
al., 2000) and the effective use of ICT is more time consuming (Trucano, 2005). This is consistent with the experience of the teacher who reported having used simulations for teaching the concept of population ecology to eleventh graders and oral hygiene to first and second graders. He affirmed that he has to invest a lot of time in order to develop these types of classes.

Furthermore, the observation of classes showed that teachers primarily use traditional pedagogical approaches in which the environment is teacher-centered. In the classes observed, students followed the teachers’ directions step-by step and used technology for drill and practice. This data is consistent with Trucano’s (2005) report that states that in developing countries, ICT has been used for the most part to support traditional teaching practices. It also seems to be similar to Hayes’ (2007) findings in Australian classrooms, in which it was concluded that most teachers are incorporating computers into existing teaching practices and utilizing them in activities that could be done without ICT.

These findings suggest that there can be two interplaying factors which affect this constructivist perspective being translated into practice. The first one is that although the teachers are sensitized and are able to point out key aspects that characterize the constructivist approach, they have neither the practical skill nor the knowledge allowing them to apply constructivist approaches of teaching on a daily basis. The second factor could be that traditional learning practices have dominated education for so long that new teaching philosophies are permeated by deeply rooted traditional approaches. Teachers
and students have been educated by other teachers and parents in traditional ways, so the transformation of this state of mind is an evolving process.

The fact that all the interviewed teachers are open to the new pedagogical changes which lead to the construction of student-centered learning environments seems to nullify the initial assumption about the influence of traditional cultural customs, particularly those of the Catholic religion on teachers’ pedagogical practice, on which this study is based. Nonetheless, the observed practices and elements found in their pedagogical discourses, deeply rooted in traditional views of teaching and learning suggest that the original assumption can be partially true. This ambivalence leads one to deduce that the mainstream teachers are in a state of awareness in regards to constructivist views of learning.

Nevertheless, there are other factors determining the uses of computers. As Becker (2001) noted, despite the importance of teachers’ educational philosophy to determine the type of technology integration, there are even stronger factors affecting technology uses. He pointed out teachers’ technical expertise in using computers, the number of computers in the classrooms, and teachers’ commitment with their profession.

Hepp et al. (2004) uses a general categorization of teachers in regards to their attitude towards ICT: innovator, resistant and mainstream. According to Hepp et al. (2004) innovators are those who are the first volunteers for training courses, are committed to the process of technology integration in the school, and in many cases become the schools’ ICT coordinators. Resistant to ICT is the teacher that has reasons to be against the integration, these reasons can vary from arguments in favor of traditional
teaching to a low level of confidence in his or her computer or other technological skills. Mainstream teachers are late adopters of technology who are the majority of teachers in most schools.

In line with this categorization, this study did not find resistant teachers. Most teachers can be categorized as mainstream. Teachers with positive perceptions about the use of technology that found barriers such as lack of adequate software, insufficient number of computers, broken down computers, poor Internet connection, low confidence in their computer skills or schedule conflicts to use computer labs.

For instance, many teachers of the private school expressed interest in using technology in their class but complained about the hassle involved when scheduling the computer lab in order to fit their class time frame. This finding suggests, as it has been affirmed by Trucano (2005) that the placement of computers into classrooms can enable higher levels of usage than having computers in separate laboratories. Teachers can feel motivated to learn about technology and take risks and experiment with new applications, conditions that according to Sandholtz, Ringstaff, & Dwyer (1997) are needed for appropriate use of technology in education.

Despite all the barriers and difficulties identified in the schools, innovators that found methods of using technology in effective ways were found. This was especially prominent in the urban public school’s case; even though there are few and unreliable computers, interesting high order or type II applications were found. The teacher who took the students out of the school to use applications that the computers in the school could not support or the two teachers that spent a lot of time developing simulations in
order to promote inquiry learning are the most preeminent experiences when it comes to
the effective use of computers found in this research. This is so not only because of the
effort to teach in new and better ways enabled by technology, but because of the fact that
they did so having the poorest equipment of the three schools studied. The computer
literacy teacher of this school is a perfect example of Hepp et al.’s (2004) definition of an
innovator. This Natural Science teacher, who after having received the computers
donated by Computadores para Educar and the training provided, became the computer
literacy instructor and the ICT coordinator of the school and has experimented the use of
type II applications of technology for teaching.

However, two important aspects related to this finding should be noted. The first is
that the exemplary experiences found in this study depended on the teachers’ will,
personal and professional motivations that led them to use of computers in order to
achieve the students’ better understanding and appropriation of knowledge. Within these
motivations, the following cases, were found; the teacher who was doing her Masters and
taking a course focused on technological applications in education, teachers who
participated in external projects related to the use of technology and applied what they
had learned, and teachers with personal interest and preference for computers and their
potential pedagogical uses.

The second aspect is that these teachers have only used type II applications of
technology on few occasions, and in their day-to-day routine they keep traditional ways
of teaching. This finding supports Maddux and Johnson (2006) claim that type II
applications of technology in education produce a change in the teacher’s approach, from teacher-centered to student centered.

It is interesting to point out that the main difference found between the rural and the urban public school was that in the latter, teachers who critically reflected about the use of donated computers and software were found, while all of the teachers interviewed in the public school expressed some sort of conformity with the computers’ feeble conditions donated by Computadores para Educar. These teachers consider that the simple use of computers and of type I applications are generating students autonomy and engagement in their learning process.

On the other hand, one teacher in the urban public school expressed that the pedagogical software donated by Computadores para Educar is not adequate enough to develop activities which implicate high order thinking. He stated that for the most part they are provided with software that support the use of technology in traditional ways. Another teacher reflected about the kind of computer skills the students received with obsolete equipment and pointed out the big gap existing between the computer skills of students from public and private schools, which have more updated technology. This gap was confirmed when comparing the resources and the type of computer instruction offered in private and public schools.

This finding confirms what Trucano (2005) and Tiene (2002) affirmed about donated and refurbished computers, in terms of their limited functionality and cost of maintenance, which, as in the case of the public schools, prevents them from being repaired and means they have a short lifespan. The Computadores para Educar
program’s goal of having an impact on the reduction of the digital divide between rich and poor students in Colombia is not being achieved. The experiences of the two public schools demonstrate that to fill rooms with obsolete computers and then claim that these computers are contributing to close the digital divide is a fallacy. Those computers are not offering students real opportunities to participate in the so-called information or knowledge society. On the contrary, they are generating a slow and frustrating adoption of computers in schools that does not have a real impact on education.

Having there are no great differences in the perceptions and beliefs of the public and private school teachers, it is feasible to assume that if the public schools improve their access to technology to the same level of the private school, students in public and private schools would use technology in a similar way. However, it should also be noted that while the use of technology only depends on the teacher’s will and a true integration of technology does not happen in the curriculum, it would not be possible to find a consistent application in the classrooms.

Based on the findings and what I have analyzed and learned from the three case studies, it can be concluded that the development of constructivist classrooms is a slow evolutionary process, which requires not only a better preparation of teachers in constructivist theories and practices but also a change in students’ expectations. Constructivism is not a recipe, however it is important in order to provide teachers with tools, incentives, and spaces in which they can experiment and develop creative ways of using ICT, involving students emotionally, so they can motivate the students with a real interest about learning.
Besides, it is important to take into account that teaching from a constructivist perspective is on a continuum. This means that teachers can have a lesser or greater constructivist approach. However, in a country like Colombia, where what is taught in schools is controlled by the Ministry of Education and all students have to complete the national curriculum in an strict order according to the grades, it is not possible to practice a radical constructivism where students lead their learning from their own interests and in their own rhythm.

This study also concluded that there are a number of difficulties related to the availability of technology that need to be overcome in order to achieve a substantial change in teaching practices. The improvement of available technology, the introduction of computers in the classrooms, training in the use of Type II applications which promotes constructivism, and technical support could lead to an effective integration of technology in schools.

It is important to keep in mind that the real challenge for schools is not in the use of technology but in making pedagogical innovations present in their tasks, which would improve the quality of the education that the students receive. Therefore, fundamental changes would require ongoing training for teachers in constructivist pedagogical practices and motivation and support for institutions.

The results of this study can be used to support a school intervention project that attempts to improve teachers’ skills in the use of technology from constructivist approaches, taking them from a state of awareness to one of action. The dissemination of these results could alert the Departamental Bureau of Education about the actual
conditions of technology availability in public schools and foster local governments to take actions to update the technology. The following recommendations are based on the findings and propose ways to address some of the issues pointed out in this study.

Recommendations

There are several recommendations to improve the current uses of technology and teaching practices in the schools of this study.

Pedagogical practices

Regarding a change in pedagogical practices is important to make students aware of the constructivist pedagogical model that it is attempted to introduce in the school. Changing traditional teaching methods that students have been used to cannot be a decision reserved only for teachers. If students are motivated to be active learners in the school they can demand from teachers more student-center approaches. The common interest of teachers and students in this process can accelerate the change expected. Furthermore, teachers need to be trained in the application of constructivist teaching approaches that allow them to move from a state of awareness about the benefits for education of a constructivist pedagogical model to the application of it.

The schools’ directives should facilitate the teachers’ exposure to the use of educational ICT and tools and projects which can serve them as inspiration, such as the free Colombian site EDUTEKA that offers teachers support and theoretical tools and practices for ICT integration in the teaching and learning process. Just as well, teachers’ experiences with type II applications in class should be highlighted and shared with the rest of the teaching staff.
Based on the idea that one teaches as one learnt, universities and schools for teachers must use constructivist models for teaching.

*Technological resources*

The government should support public schools to improve their technological conditions. As has been mentioned before, refurbished and donated computers are not a good solution. The use of obsolete equipment can cause frustration and rejection to use technologies. The acquisition of better equipment and the introduction of computers to the classrooms would foster an increase in the use of technology in subject areas.

The institutions that do not have the economical resources to equip the school with licensed software should consider the use of Linux and other open source software. This free operating system can be used on old computers such as the ones donated by *Computadores para Educar* because it requires less memory and disk space. Besides, Linux allows the use of many programs compatible with Microsoft Office and because it is free students can have copies to install in their homes without dealing with license management.

*Further research*

It would be interesting to research teachers who are integrating ICT in their classes and using type II applications in order to understand their motivations, what has inspired them, the obstacles they have faced and their end results.

It is also important to take a more profound look of this topic from the students’ perspective. The results of this study showed that students who affirmed having received integrated classes did not remember anything about what they learnt. This leads one to
ponder on: How aware and active are the students of their learning process? How is the use of these computers contributing or motivating their learning? Those are interesting questions for future research.
REFERENCES


