ATHABASCA UNIVERSITY

LARGE-SCALE DEPLOYMENT OF TABLET COMPUTERS IN BRAZIL: AN IMPLEMENTATION MODEL FOR SCHOOL DISTRICTS

BY

GIOVANNI FERREIRA DE FARIAS

A DISSERTATION
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF EDUCATION

CENTRE FOR DISTANCE EDUCATION

ATHABASCA UNIVERSITY
JULY 2016

Approval of Dissertation

The undersigned certify that they have read the dissertation entitled

**"Large-Scale Deployment of Tablet Computers in Brazil:
An Implementation Model for School Districts"**

Submitted by

Giovanni Ferreira de Farias

In partial fulfillment of the requirements for the degree of

Doctor of Education (EdD) in Distance Education

The thesis examination committee certifies that the thesis
and the oral examination is approved.

Supervisors:

Dr. Mohamed Ally
Athabasca University

Dr. Fernando José Spanhol
Universidade Federal de Santa Catarina (UFSC)

Internal committee member:

Dr. Nathaniel Ostashewski
Athabasca University

External committee member:

Dr. Rozhan M. Idrus
Universiti Sains Islam Malaysia (USIM)

July 05, 2016

1 University Drive, Athabasca, AB, T9S 3A3 Canada
P: 780.418.7536 | Toll-free (CAN/U.S.) 1.800.561.4650 (7536)
fgs@athabascau.ca | fgs.athabascau.ca | athabascau.ca

Dedication

To my sister Gislane, from whom I received the support to afford the best education available in my homeland including English language studies, when I was in the early stages of my student life. Her support at that time was decisive for ensuring my professional success and achieving a doctoral degree.

Acknowledgements

I want to express, herein, my deepest gratitude to those who helped me to reach this goal in my academic life. First of all, I want to thank my family, my wife Nilda Maria and my sons Mateus and Rafael. They have been my inspiration to aspire this doctoral degree and in overcoming all the challenges of living in my new country.

I thank my parents, who gave me the educational conditions to study since kindergarten until I obtained my Masters degree which eventually granted me the opportunity to join the Distance Education doctoral program from Athabasca University.

I thank my supervisor Dr. Mohamed Ally and my co-supervisor Dr. Fernando José Spanhol, who guided me through this academic saga.

I also thank Prof. Sirléia Rosa, from the University of Montreal, who provided a letter of reference when I applied to the Athabasca University doctoral program, and shared her knowledge on qualitative research with me all my through doctoral studies.

I need to mention how important the support from Alberta Innovates - Technology Futures was as they awarded me financial support for my doctoral research. I also like to thank and congratulate the Government of Alberta for their initiative in promoting research and innovation.

Lastly, and most importantly, I express my gratitude to my Almighty God, who gave me the wisdom, the opportunity, and the tools to allow me to achieve this academic degree.

Abstract

The Brazilian economy faced a sharp growth between 2002 and 2012, provoking a skilled-worker shortage all over the country, which affected all the economy sectors and threatened the growth in its keenest period. The poor basic education indicators worked as an argument to identify the low quality of basic public education as being one of the main reasons for this problem. One of the initiatives of the Brazilian government to face this problem was the distribution of 600,000 tablet computers among teachers of public schools all over the country. The goal was improving teaching processes and boosting the student's learning outcomes significantly with the use of richer and more dynamic content. However, there were complaints about how the deployment was performed, resulting in refusal from teachers to use the tablet computers and criticism from scholars on the initiative.

Thus, this study focuses on the identification of the most important factors to be considered in such deployment in the Brazilian public schools, considering the standpoint of those professionals directly involved with the process and located all over the country, such as teachers, principals, managers, technicians and education policymakers. The study used the Straussian approach of Grounded Theory to analyze the data collected by online survey, interviews, and school visits done in five cities located in different regions of Brazil.

This dissertation presents a model that describes sixteen main factors to be considered in such large-scale deployment, as well as their relationships with each other, in order to improve the deployment process and mitigate potential problems. The findings also revealed the problems found in the deployment processes undertook in different cities of Brazil, exemplifying what must be done and what must not.

This study fills a gap of investigation on what happens before the tablet computers are implemented in the classroom, during their deployment phase, especially when it involves the large-scale number of devices. There is the expectation that the Large Scale Mobile Device Deployment (LMSDD) model, resulted from this study, can be a guide for future deployments of tablet computers in schools.

Key words: tablet computer, public school, Brazil, deployment, large scale, model.

Table of Contents

List of Tables

List of Figures and Illustrations

List of Abbreviations

BADE..... Brazilian Associacion for Distance Education

BEDI ..... Basic-Education Development Index

bps ..... bits per second

BYOD ..... Bring Your Own Device

CIA..... Central of Intelligence of America

COL..... Commonwealth of Learning

DL ..... Distributed Learning

ETC ..... Educational Technology Centre

GDP ..... Gross Domestic Product

GPL ..... General Public License

GTS ..... Georgia Tech Savannah

IT ..... Information Technology

ICT ..... Information and Communication Technology

IWB..... Interactive Whiteboard

LSMDD ..... Large-Scale Mobile Device Deployment

NPDB..... National Program for the Didactic Book

OECD..... Organization for Economic Co-operation and Development

OER..... Open Educational Resources

PDF ..... Postscript Document Format

PISA..... Programme for International Student Assessment

UNDP..... United Nations Development Programme

UNICEF ..... United Nations International Children's Emergency Fund

USD ..... United States Dollar

List of Terms and Definitions

Auditing: Deployment factor that implies assessing the teacher engagement in the tablet computer project. The auditing process is guided by plan made by the policy makers. At the same time, the results obtained from the auditing process guide the policy makers to adjust the plan in order to optimize it, besides they feed the dissemination of information about the deployment outcomes among the school community.

Boosts: Verb used in the LMSDD model to describe the meaning of improvement or motivation. For instance, the digital inclusion improves the teacher engagement on the tablet computer project, which can be motivated as well by the leadership of a college or of a school principal.

Digital inclusion: Deployment factor that indicates the ability of teachers to use information and communication technologies available to engage effectively with the tablet computer project.

Dissemination: Deployment factor that indicates the communication performed by the management staff of schools and school districts to the related community about the tablet computer project, such as teachers, staff, students, and student's parents.

Enables: Verb used to describe the act of empowering the teacher engagement to the project, either because the existence of infrastructure, hardware, or training. Together, these three deployment factors compose the minimum condition to allow the teachers to engage effectively with the deployment process.

Guides: Verb used to indicate that one deployment factor gives directions to the behaviour of another factor. Following this logic, the factor curriculum guides the work of the pedagogical support; the factor methodology guides the teacher engagement, as long as the classes follows its instructions, the deployment planning gives directions to the dissemination process over the tablet computer implantation and the auditing process.

Hardware: Deployment factor that involves the equipment used for implementing the idea pursued by the deployment, which is to use tablet computers to present rich content classes for students in a classroom with the use of projectors or interactive whiteboards.

Improvement of high-school education: Implies obtaining better results in national and international education evaluations which measure the quality of education in a country based on the performance of a sample of students on high school assessment tests.

Improves: Verb used to enhance the performance of a factor based on the presence of another. For instance, the factor digital inclusion for a teacher is improved by his/her engagement with the tablet computer project since it stimulates mastering the use of the involved technologies. Another example can involve the technical and the pedagogical supports that can improve the

teacher engagement to the tablet computer project. As long as there are these two types of support, the teacher has specialized help to overcome technical and pedagogical barriers to using the tablet computer, the chances of engaging effectively to the tablet computer project rise.

Infrastructure: Deployment factor that is related to all the physical and technological structure to make feasible the use of tablet computers in classrooms in a school. It includes the existence of a set of resources, such as appropriated rooms, furniture, electrical installation, projectors, interactive whiteboards, and a good quality internet connectivity throughout the school.

Introduce technology to enhance education: Act of using technology based on laptops to develop rich content to be used in tablet computers, which is used to present the content in a classroom through projectors and interactive whiteboards. The objective is to enrich the classes presented by teachers with the exploration of dynamic graphs, information from the web, videos, and all kind of resources to make the presentations more dynamic, interesting, and impactive to improve the learning outcomes.

Leadership: Deployment factor that indicates the presence of formal or informal leadership that can lead the group of teachers in a school to use the tablet computers for the purpose which was planned for the tablet computer project.

Low-quality basic education: Indicates the lack of enough learning outcomes obtained by Brazil students, mostly those that depend on basic public education. This problem is observed by the difficulty the high-school graduates face to get trained for skilled-worker jobs. The low marks in international educational assessments also reveal this low-quality basic education due to the low marks reached by Brazilian basic education students in comparison to their peers from developed countries.

Maintenance: Deployment factor that involves protocols, resources, and services needed to replace in a fast-track way the defective equipment involved in the tablet computer project. It includes replacement equipment to immediately be used in place of defective devices sent for maintenance and efficient logistic to send and receive back the broken equipment.

Methodology: Deployment factor that involves the directions to use digital educational resources within the context of the tablet computer project. These directions might be documented in a way that can be shared among different teachers in a standardized protocol or developed by teachers for their own use in their educational contexts.

Pedagogical support: Deployment factor that involves the school staff or the school district staff that provides training and support for the teachers on the use of tablet computers in their classes in what regards to pedagogical issues, such as choosing or producing educational resources, planning classes within the context of the use of tablet computer, and modifying the syllabus according to the new perspective brought by the use of the mobile devices. t**Planning:** Deployment factor that involves the actions of designing the strategy for the tablet computer project. It involves establishing rules for auditing the teacher engagement to the project and disseminating the project within the community, besides defining the curriculum that fits in the

new educational reality with the use of the mobile devices for presenting classes. Finally, planning needs to specify the policies applied to different factors of the deployment.

Policy: Deployment factor that present details regarding procedures that must be strictly followed during the implementation of different deployment factors. The policies differ from the planning in the level of details. While the plan must present in a more superficial and generic level of details, the policies must indicate details on procedures related to other deployment factors, and can vary from one state to other, from one school to other.

Stimulates: Verb used to describe the act of motivating the teacher engagement through the communication performed by the educational leaders to explain and details how the deployment will take place, how the use of tablet computers in classroom will improve the educational process, and the path that must be followed to reach the effective accomplish of the results expected for the tablet computer project.

Teacher engagement: Deployment factor that implies in the adherence of the teacher to the tablet computer project, with the effective use of the mobile device to present their classes. At the same time, teacher engagement also is the main goal of the implementation since all initiatives are focused on guaranteeing that the teachers will have the conditions to use the tablet computer to present classes to their students in a classroom, with the use of the interface of interactive whiteboards or projectors.

Technical support: Deployment factor that involves the school staff or the school district staff that provides training and support for the teachers in the use of tablet computers in their classes with regards technical issues, such as equipment setup, software installation, and operational system and software configuration.

The need to improve teaching methodology: Regards to the necessity of changing the way in which the teachers present their classes to obtain better learning outcomes from their students.

Training: Deployment factor that involves providing instruction and practice for all staff and teachers involved in the use of tablet computers, the peripherals, the content, and the infrastructure to enable the effectiveness of the tablet computer project.

World-class education: Level of education which leads the student to reach marks in the same level of the top countries in the rank of the Programme for International Student Assessment (PISA), an international assessment managed by the Organisation for Economic Co-operation and Development (OECD).

Chapter 1

INTRODUCTION

This research focuses on the factors that influence the large-scale deployment of tablet computers in a Brazilian public high-school districts, which involves hundreds of thousands tablet computers. This deployment has been taking place since 2012 across Brazil with a lot of criticism from pedagogues and scholars (Cardoso, 2012). The Brazilian Federal Government was supposed to distribute at least 600,000 mobile devices among high-school teachers to improve their teaching methodology supported by 3,700 interactive whiteboards (G1, 2012a; Santana, 2012; Lima, 2013). As there have been other similar large-scale deployments across the world, depicted in Chapter 2, which face difficulties and flaws (Garun, 2012; Hazarika, 2012; Frank, 2013; Daily Sabah, 2014; Faas, 2013; Today's Zaman, 2015; Sakawee, 2013; Sakawee, 2014; Kastrenakes, 2014; Neves and Cardoso, 2013), it is important to understand what are the reasons of the difficulties in dealing with large scale deployment. Therefore, the implementation of this research creates the opportunity to understand what boosts and what prejudices a large-scale deployment of tablet computers in a nationwide operation, involving hundreds of thousands of devices and several thousands of teachers. This research aims to investigate the factors, according to the deployment stakeholders, for or against the success of the operation during the deployment process of the tablet computers. Moreover, based on these factors and their relationships with each other, this research also generated a conceptual model that can be used in guiding a large-scale deployment of tablet computers. Although this model was built based on the research done over the deployment of tablet computers in public high-school districts in Brazil, it is generic enough to be used in educational scenarios other than the Brazilian one.

Background of the Study

Brazil is the world's fifth largest country, occupying approximately 8.5 million square kilometers, with a population of 190 million people. Its economy is the world's eighth largest by Gross Domestic Product (GDP), which translates into approximately $ 1.9 trillion USD (CNN Money, 2015). The Brazilian income per capita income in 2013 was $11,208 USD (World Bank, n.d.). Its economy is built on a diversified industry, which ranges from basic industries, such as metallurgy and cement (Banco Nacional de Desenvolvimento Econômico e Social, 2011) to high-tech industries, such as the automobile, satellite, aircraft, information and communication technology, and nuclear submarines (Castellano, 1996, chapter 2).

Due to its large natural resources and agribusiness platform, Brazil is one of the world's largest players in the commodities market, trading in iron ore, oil, soy, sugar, and meat. Based on this geographic scenario, the Brazilian economy has been obtaining an outstanding position in the world market regarding its steady growth during the last decade, as states the CIA fact book (2015, para. Economy):

> Brazil's economy outweighs that of all other South American countries, and Brazil is expanding its presence in world markets. Since 2003, Brazil has steadily improved its macroeconomic stability, building up foreign reserves, and reducing its debt profile by shifting its debt burden toward real denominated and domestically held instruments. Unemployment is at historic lows and the Brazilian traditionally high level of income inequality has declined for each of the last 14 years.

Although Brazil has a strong industry and agriculture base, these are not the largest components of the Brazilian GDP. While industry represents 26.3% and agriculture 5.2% of the Brazilian GDP, the service sector contributes to more than 68.5% (CIA, 2015). This GDP

distribution is known as an economic stage called post-industrialization, in which people's income rises and they demand more services, such as education, health, and entertainment. (Soubbotina & Sheram, 2000, p. 51). However, the service sector does not grow as fast as the agricultural and industrial sectors do regarding skilled workers and productivity. Moreover, this sector requires more human capital, which means having more educated labour (Soubbotina & Sheram, 2000, p. 52). In other words, having better-educated labour contributes to the development of the service sector and, consequently, of the GDP.

What has happening in Brazil is a phenomenon related to this issue mentioned by Soubbotina & Serman (2000). Basically, the lack of qualified labor prejudiced the economy in the beginning of this decade (Estadão, 2011) and the low quality of public basic education is cited as being one of the origins of the shortage of skilled workers.

The tablet computer deployment planned by the Brazilian government was just one in a set of initiatives, later described in this chapter, aimed to improve the quality of the high-school graduate students. By doing so, the expected result was to have better skilled workers to collaborate to the economic growth in Brazil (Burnier & Gonçalves, 2012; Gomes, 2012).

The next section describes in more detail the Brazilian economic and educational problems, and after the resolution options that the Brazilian society tried to overcome them.

The Brazilian Problems

The extent of Brazil's economic problems at the time that the tablet computer distribution project was conceived is outlined below. It is followed by a detailed description of how tablet computers were supposed to be used in the Brazilian public education system.

Economic problem. Since 2014 Brazil has been facing an economic crisis, with a recession that reduced its GDP by 3.6% in 2015 (Diário do Commércio, 2016). However,

between 2002 and 2012 the Brazilian economy had expanded by 50% (IBGEa, n.d.). This growth unveiled the existence of serious educational problems between 2002 and 2012, especially at the basic education level. Between 2004 and 2012, the labour market exhibited a growing number of available job openings, but Brazilian workers could not fill many of these positions because of a lack of proper education (Amorim, 2012). In order to meet the demands of the labour market at the beginning of this decade, the Brazilian government had launched an international campaign to bring skilled Brazilian expatriates back from different countries, such as Japan, the United States, and Western European countries. Moreover, changes in the Brazilian immigration law were considered to facilitate the acquisition of work visas by skilled foreign workers (Secretaria de Assuntos Estratégicos, 2013). Although the law had not yet changed, and the current rules were very strict, there were 1.5 million foreigners legally working in Brazil by 2012 (Amorim, 2012).

Despite these efforts, Brazil continued to struggle to supplement its labour demands until the end of 2012. At that time, Brazil's unemployment rate was less than 5%, which was the second lowest in Brazil's recent history (Terra, 2012a). The numbers could have been further reduced through improved basic education, as high numbers of skilled professional positions remained unfilled because of the lack of qualified workers. Moreover, the inability of potentially unqualified workers to obtain the required training caused 57% of Brazilian companies major difficulties in finding skilled workers in 2011 (Amorim, 2012). These disadvantageous statistics were only behind Japan (80%) and India (67%) (Bom Dia Brasil, 2013). According to Lazzareschi, the low quality of basic education in Brazil made it extremely difficult for potential workers to obtain the necessary skills or to secure better positions (2010, p. 198).

Educational problem. The symptoms of Brazil's labour market problems are not difficult to find: 27% of the literate population between 18 and 64 years do not understand what they read in Portuguese (G1, 2015). This situation is called functional illiteracy (Bruini, n.d.). Furthermore, 20% of students who complete junior high school and who live in large cities do not master the reading and writing standards. The Programme for International Student Assessment (PISA), an international assessment managed by the Organisation for Economic Co-operation and Development (OECD, 2012), also detected the education problem described within. The PISA 2012 report demonstrated that Brazil occupied the 55th position in a group of 65 countries whose students were assessed. The Brazilian position dropped to 58th for Mathematics and to 59th for Science.

There is a perception of quantitative improvement over the years. The PISA 2012 report indicates that the enrolment rates for 15-year-olds grew from 65% in 2003 to 78% in 2012. However, the quality of the education did not increase, since the Brazilian results in the PISA 2012 report were lower than in PISA 2009 report (OECDb, 2009). Furthermore, the data analysis on the high-school dropout rate, gathered by the UNDP (United Nations Development Programme), indicates that, 24.3% of students between 15 and 17 years old leave school before graduating (UOL, 2013).

It is important to note that these results involved two different education systems: public and private sectors. According to the Brazilian Federal Constitution (1988), the basic public education in Brazil must be divided between city governments (grades 1 to 9) and state governments (grades 10 to 12). The federal government handles the post-secondary level however it can supervise and interfere at any educational level. The private sector, which may operate at any level of education, ends up offering much better basic education for those who can

afford it (França & Gonçalves, 2010). The result is an educational segregation: approximately 85% of the population depends on basic public education for their children. The rest, 15% of the population, accesses a better quality education, including schools with world-class education quality (Taffarel & Albuquerque, 2011).

Therefore, if only students from the public basic education system performed the PISA, then the results obtained in Brazil would be even worse than the current ones. Moreover, it is important to realize that to give sustainability to its development, Brazil has to count on society as a whole with access to good quality education for their society as a whole, and not just on a small elitist segment. The shortage of skilled labour and the social problems aforementioned, are related to the quality of the basic education provided for most of the population, and the Brazilian leaders are aware of this issue (Estadão, 2011). This fact can be confirmed by the initiatives taken by the Brazilian government to overcome the low quality of public education, some of them listed below.

Resolution Initiatives

Since the beginning of this century, multiple Brazilian federal administrations have been working to improve basic public education in Brazil in the last two decades. Among the initiatives that have been taken, some can be highlighted:

(1) Mandatory school attendance for school-age students (4-17 years old), resulting in an increased rate of registered students to 97.3% in 2018 (Todos Pela Educação, 2016).

(2) The Brazilian parliament has established a limit on the number of students per classroom to improve the quality of the interactions between students and teachers in the classroom. The limits are 25 students per class in middle schools and 35 students per class in high schools (Lemos, 2012).

(3) A law was passed establishing a minimum wage for teachers (Piso Salarial Profissional Nacional, n.d.), aiming to make the profession more attractive to the labour market.

(4) The federal government has launched a web portal dedicated to teacher online training and open educational resources delivery (Ministério da Educação, 2011a). Any Brazilian teacher can use this open educational resource repository, available on the web-portal (URL: http://www.portaldoprofessor.mec.gov.br), either from the public or the private sector.

(5) The federal parliament has approved an Act that establishes an increase in educational investments from 6% (current percentage) to 10% of the GDP (Plano Nacional de Educação, 2014; Oliveira, 2012; Valor Econômico, 2014).

(6) Since 2005, the performance of each public school is assessed to identify weaknesses so that each unit can make improvements (Ministério da Educação, n.d.). This assessment is called Índice de Desenvolvimento da Educação Básica (IDEB) or Basic-Education Development Index (BEDI).

Basic-Education Development Index (BEDI). Most of these initiatives have already been implemented, and some results can already be observed from the results obtained by the schools in the BEDI. The students of each school are assessed using a standard learning outcome test, and their average mark results in the BEDI score for that school, which is expressed on a scale that goes from zero to ten (Terra, 2012b). The schools are supposed to reach a minimum score, which increases every two years until the beginning of next decade. By the end of 2021, the elementary schools (grades 1-5) must reach the score of 6, the middle schools (grades 6-9) 5.5 and high schools (grades 10-12) 5.2 Terra, 2012b). Although the scores of high-school students have been improving on an annual basis, the pace of improvement has been slower than expected. Between 2005 and 2011, the high-school average score went from 3.4 to 3.7 (G1,

2012b). In the same period, the average score for grades 1-5 went from 3.8 to 5.07 (G1, 2012b), which demonstrates that the improved quality of education in the first years of basic education is overshadowed by the lower quality high school education. Therefore, the scenario of the low level of quality of basic public education, especially in high school, is far from being changed as expected. This situation contributes to maintaining of the current shortage of skilled labour since low-level educated can compromise the economic growth for the next several years. A solution should be found to reverse this situation, which is described in the next section.

The tablet computer initiative. In 2011, after several years of experimenting with different technological education devices, mostly notebooks, the Ministry for Education announced that the federal government would buy 600,000 tablet computers for distribution amongst high-school teachers (G1, 2012b). The investment of $90 million USD also includes computers, projectors and interactive whiteboards (IWBs) for the classrooms. Thus, teachers would be able to use their tablet computers to teach classes and project content on the IWBs. At the beginning of 2013, the first tablet computers arrived at schools in different places throughout Brazil. Since then, efforts by the Federal Government have been focusing on the most emergent issues: teacher training, school Internet connectivity, and open educational resources.

Although 87% of the public schools in Brazil count on broadband Internet connectivity (Costa, 2011), the Ministry for Education and the Ministry for Communication negotiated with the telecommunication carriers in order to improve the public school Internet connections and expand their Wi-Fi coverage (Posseti, 2012). The improvement of the Wi-Fi infrastructure was a necessary precondition to support the introduction of 600,000 tablet computers in high schools. The plan was to provide teachers (and later students) with tablet computers to improve the capacity of teachers to deliver more effective lessons and to enable students to obtain needed

knowledge and skills. Mercadante (2013), Brazilian minister of education and conceptor of the tablet computer project, states that once the teachers use tablet computers in classroom to present the subject-matter concepts in a more attractive and productive way, using videos, audios, illustrations, animations, among other sources of rich media, it will enhance the student's learning process and will stimulate them to study more. The expected results, according to Mercadante (2013), is that this more dynamic and "sophisticated" way of presenting classes will enhance the student's learning outcomes, without detailing the methodologies that could underpin such expectation.

Thus, stakeholders can speed up the improvement process as a whole and take advantage of the growing use of mobile devices in the country (Posseti, 2012).

The Brazilian population has 283 million active cell phone lines, i.e., a per capita mobile device penetration rate of approximately 138% (Teleco, 2016). Moreover, Brazil is the fourth largest mobile-device market in the world, right behind China, the United States of America, and India. In 2014, 70.3 million mobile phones were sold, 91% of them were smartphones (TI Inside, 2015).

Among the Brazilian youth (between 9 and 17 years old), 53% of them use smartphones and 16% use tablet computers to access the Internet (IDGnow, 2014). Therefore, these numbers indicate that there are good social and technological conditions for the successful use of mobile devices in the classroom in Brazil. The process that is now taking place is important, not only for the improvement of teaching methods in high school, but also regarding potential influence on the future of distance education as a whole.

The federal government has rushed to deploy tablet computers to see better results in school achievement as soon as possible (Terra, 2013). National education leaders stated that if

the devices were correctly used, they could promote a revolution in the quality of high-school education (Terra, 2013).

After some months of purchasing and distributing the tablets, the first teachers began training in the use of tablet computers at the beginning of the 2013 academic year, which starts in February and ends in December. There is no official information as to whether tablet computers will also be distributed to the 7.5 million high school students in Brazilian public institutions in the future (INEP, 2015). Therefore, the tablet computers were supposed to be used by the teachers, at first, to prepare content and present online content through the interactive whiteboard or projectors.

The content to be presented by the teachers that adhere to using the tablet computers is supposed to be available on the Internet, distributed by websites such as the Portal do Professor (Teacher's Portal), YouTube, TV Escola (Government website with educational content in video format), etc. This portal hosts the open educational resources that may be used by any teacher. The Brazilian public universities also are supposed to develop public domain content to be used by the teachers with the devices (Paraguassu, 2013).

Statement of the Problem

It is important to understand some deployment issues regarding the tablet computer initiative, to understand the problems this research aims to solve, which are discussed below.

Tablet computers have been successfully used for educational purposes by private schools, along with interactive whiteboards and 3D projectors for pedagogical activities (Nascimento, 2013). Some private higher education institutions have also adopted this practice, including Estácio de Sá University, a private institution that has distributed 20 thousand tablet computers among its students and professors (Convergência Digital, 2012). Although these

privately funded initiatives of using the tablet computer for educational purposes seem to be similar to a public funded initiative, there is a substantial difference between them. The main difference was the deployment scale. The private sector had better control over the deployment of a few thousand tablet computers distributed to a few schools or university facilities while the government initiative involved hundreds of thousands of devices and dozens of thousands of schools.

The policy-makers in the private sector work close to the environment where the mobile devices are used for educational purposes. However, the policymakers in the public sector are based in Brasilia or the capital of each state, i.e. they are far from most of the places where the tablet computers are supposed to be used. Thus, for the public sector, it is harder to supervise the application of the educational policies.

Since the Brazilian federal budget for education is much larger than most state and city budgets (Stranz, 2008), there is dependence, of most of the Brazilian states and cities, on the federal government for investing in innovation for basic education. In practice, the state or city governments manage their high-school education systems, build their schools, hire and pay their respective teachers, and impose their operational rules. When significant investments are needed, most state and municipal governments need to seek federal funds. The case of the introduction of tablet computers in high schools epitomizes this situation. The idea of deploying tablet computers came from the Ministry for Education, i.e., from the federal government. From this idea, a project was created, and the states were invited to join. Twenty-five states (out of 27) had adopted the program in the first call, still in 2012. Their respective state departments of education started receiving the tablet computers and arranging for teacher training (Ministério da Educação, 2012).

Despite these initiatives, the introduction of tablet computers in high schools has been bombarded with criticism from different segments of society, especially from scholars. Cardoso (2012) states that "introducing tablet computers in the classroom means more of the same." She points out that there is much government enthusiasm at the beginning of the process, but after some time, research shows little or no significant results from the use of the technology. She names this phenomenon "politician technophile." Teles (2012) states some factors that feed the criticism, such as the lack of broader curriculum planning to support the new technology, the absence of defined standards for the content available for the teaching process, and the uncertainty of when the students will also have tablet computers available for them.

There were practical issues involved as well which spurred more criticism. For instance, there are complaints about technical problems regarding Internet connectivity in some schools. Even where the tablet computers were already in use, their connectivity problem prevents the adequate use of the tablet computers by teachers (Ferreira, 2013).

Moreover, the use of tablet computers faced the lack of knowledge amongst teachers on how to effectively use them as a pedagogical tool (Ferreira, 2013). This skill gap makes the teacher training a critical step for the success of the initiative. Despite this problem regarding the lack of training, Lima criticized the fast-track way in which teachers are being trained to use the tablet computers (2013). As the teacher training on the use of the tablet computer was managed by each state, there was no standardization with respect to this issue. Some states performed this training in two months (NTE Videira, 2013) while others did it in intensive one-day workshops (Imparcial, 2013).

The access to digital content is another area of concern for the Brazilian tablet deployment initiative. Santana (2012, p. 136) states that the National Program for the Didactic

Book (NPDB), which distributes paper books among public schools yearly, now includes digital content in the distribution, produced by private publishers. Because teachers in the public education system can use these digital files freely, they are called Open Educational Resources (OER). However, they must be used as they are, i.e., changes, adaptations, improvements or localization of the content are not allowed. It is causing the purpose of OER to be compromised since the publishers (private companies) try to keep their control over the copyright of the content provided to the NPDB.

The deployment issues mentioned in this section were confirmed in this research, in which high-school teachers who received the tablet computers expressed their frustration with the use of the equipment. The main complaint is the lack of pedagogical training, infrastructure, and knowledge to use online content for delivery on mobile devices. In fact, as detailed in Chapter 5, receiving the tablet computers and having just few hours of operational training on the use of the hardware were just what was offered for the teachers to adhere to the idea of using mobile devices for teaching purposes. Furthermore, there was no pedagogical approach or even further instructions about methods and specifications for the effective use of the mobile devices for teaching purposes.

Research Objectives

In the context shown in the previous section, this study aims to identify the main factors to be considered in a large-scale tablet computer deployment in school districts. Moreover, this study intends to depict the relationships between the factors, as well as the order of precedence between them. These findings are intended to be presented within a model for this type of deployment, which is based on the perceptions of those who have already experimented with the deployment and use of such mobile devices in a public high-school environment.

The results can guide educational policymakers and implementers (school principals, teachers, and technical staff) who are involved in deploying tablet computers for educational purposes on a large scale, not only in Brazil but also in other countries. A secondary outcome of this research is to determine possible reasons why this kind of educational technology has been showing negative results when deployed on a large scale; which has been revealed by statistics and user impressions in Brazil and other countries around the world.

Importance of the Study for the Brazilian Education

For the educational community involved both directly and indirectly with the use of technology for educational purposes, the large-scale deployment of tablet computers is an important step in the improvement of the high-school education in Brazil. Despite previous initiatives which introduced technology to enhance the education in public schools, such as the use of computer labs and interactive smart boards, the use of mobile devices for education involves hardware that a significant part of the students can afford. The market stats indicate that 84.2% of the mobile phones sold in Brazil between October 2013 and September 2014 were smartphones (Teleco, 2016). It demonstrates that such devices are very popular, and once the use of mobile devices for educational purposes becomes a success, a significant part of the students will be able to take advantage of it using the BYOD (Bring Your Own Device) policy.

The results of this research will help scholars and practitioners to understand the main factors to be observed in large-scale deployment of tablet computers in Brazilian public high schools. Moreover, the model developed from this research can facilitate the identification of existing gaps to be filled in deployment processes. Thus, the effective introduction of mobile devices in public high school districts in Brazil, or wherever there is similar educational structure and policy, is made easier and faster. This study creates new branches of scientific investigations

concerning the best practices when using mobile devices for an innovative paradigm for teaching the youths in regards to a very practical issue: its initial implementation in large scale operation.

Scope of the Study

Since this study is based on a qualitative research methodology, the researcher must make some choices and commitments to define the limits of the phenomenon to be studied (Fernandes & Maia, 2001, p. 55). Thus, the scope of the study is restricted to the public high-school educational system in Brazil. This means that only professionals somehow related to the schools that have received the tablet computers within the project managed by the Brazilian Ministry for Education participated in the data collection of this research. Among these professionals might be included: teachers, principals, support technicians, pedagogues, managers, and scholars. Note that, in Brazil, pedagogues are commonly known as professionals specialized on planning educational processes, overseeing their execution performed by teachers, although the pedagogues frequently assume the role of teacher in this process. This role played by pedagogues are supported by the National Council of Education, which formally states the professional activities that must be done by pedagogues, highlighting their role in educational planning and supervision activities (Conselho Nacional de Educação, 2006).

Furthermore, the study is focused on the tablet computer deployment itself. This means that the processes that are involved go from the product specification and distribution logistics planning up to and including the activities regarding the pedagogical use of the devices. It is important to notice that what happens inside the classroom, after the tablet computer be deployed and be in use by the teacher, is not focus of this study. Therefore, the focus of this study is limited to the moment in which the teacher receives the mobile device and accepts using it for

presenting classes. What happens after the deployment, or even whether the use of the tablet computer in classroom was successful or not, must be subject of other study.

The specification of the scope of this study also must define how many tablet computers should be considered a large-scale tablet computer deployment. As the deployment scale is very dependent on each study context, it is important to define a large-scale deployment of tablet computers in education as those initiatives that reach at least tens of thousands of devices. The reason to consider this threshold is the need for a minimum amount of devices to influence the deployment factors, such as logistics, infrastructure, training, and support (Bassi, 2010).

Finally, it is important to clarify that this study does not aim to assess the Brazilian deployment, despite some comments about it are presented in Chapter 5. Although the data collected during this research can indicate some clues about the level of success of such an initiative, the research design established for this study is not appropriate to find out whether the deployment was successful or not.

Outline of Dissertation

This document consists of seven chapters: (1) Introduction, which presented the significance of this study; (2) Literature Review, which presents the scientific background on the study's subject; (3) Theoretical Framework, which presents the theory in which this study underpins its research methodology; (4) Methods, which depicts how the research was implemented; (5) Results and Discussions, which presents the results obtained in the study with the considerations defended by the researcher; (6) Tablet Computer Deployment Model, which is the resulting model arose from the grounded data collected and analyzed in the research; and (7) Conclusions, which presents the impressions and ideas obtained from this study by the researcher. Moreover, there are seven appendices: the support letter from BADE, the letter of

information for the research participant, the online survey questions, the online letter of consent, the table of categories and codes, an alternative model graphical design, and the research ethics board approval.

Chapter 1 Conclusion

This chapter presented details on the Brazilian social and educational scenario, as well as its economic and educational problems that motivated the tablet computer deployment in Brazil. After, this chapter presented the initiatives of the Brazilian Federal Government to overcome the educational problem, highlighting the tablet computer initiative.

After, the problem was stated formally with details on the research objectives. Then, this chapter described the significance of this study and the outline of this dissertation.

The next chapter will present the literature review on the deployment of mobile devices in education. It will start by delimiting the scope of the literature review. This is followed by the literature on the use of tablet computers with different approaches. Then, the main government-supported tablet-computer deployments are described with additional information about the results and impressions obtained, especially regarding the Brazilian deployment.

Chapter 2

LITERATURE REVIEW

The first section of this chapter establishes the scope of the literature review since the use of tablet computers is a relatively recent phenomenon; and if one considers the large-scale use of such devices in education, it is still more recent. Thus, this section establishes the time thresholds for the literature search and determines the content of the following two sections.

The second section depicts the research done on the use of what was then called personal tablet computers in education in small-scale deployments. The third section describes the literature review in what this study calls the iPad era, i.e. the period in which tablet computers came to be used on a large-scale for educational purposes.

The fourth and fifth sections of this chapter examine the results obtained by the government-supported tablet computer deployments, respectively, around the world and in Brazil specifically. Both sections present the number of tablet computers that were deployed some years after being announced, as well as the impressions found in the literature about the problems faced by the first users of the tablet computers.

As mentioned above, the sections one to five highlight some factors that influence the use of tablet computer in a school environment. The sixth and final section of this chapter presents the main factors considered in a large-scale tablet computer deployment according to a wider literature search.

Scope of the literature review

This literature review started by establishing what year tablet computers started being used on a realistic scale in schools. This means involving, at least, a whole class of students

effectively using the devices for educational purposes. Hence, from this year moving backward, the studies and scientific publications on the use of mobile devices for education were considered for this literature review.

The use of tablet computers in schools is a relatively new phenomenon, although this kind of hardware has been available on the market since 1987 (Bort, 2013). According to Whitefield, "since 2000, the evolving tech educational environment has grown considerably, with the use of tablet computers, cloud computing, podcasts, Web 2.0, e-tivities and online delivery" (2012).

Until 2010, tablet computers never had success with the general public, being strictly used by specific niches of the market and some innovators, including the educational sector. It happened mainly because of the high price of the tablet computers and the other reasons, such as the lack of integration between hardware and software, a very heavy device for continuous use on hands, and possibility of scalding and short-lived batteries (Spillers, 2009).

The research in the personal tablet computer era

Although there are limited studies on the actual large-scale deployment of tablet computers during the last ten years, some papers bring this topic to light. Most of them focus on the adoption, behaviour change, and learning outcomes fostered by the use of the one-to-one mobile devices, i.e. tablet computers used either by teachers or by students (McGee & VanderNoor, 2013, pp. 12-13).

When reviewing the literature, "tablet personal computer" was the predominant term used to describe the use of mobile devices for education. This term was found in references published during the last decade, at a time in which the operating system was devoted to desktop computers with few adaptations to the mobile hardware features. For this study, regardless the term used in

the literature, the term "tablet computers" will be used to refer to mobile devices that may be considered a "general-purpose computer contained in a touch-screen panel. Although earlier tablet computers required a stylus, modern tablets are operated by fingers, and a stylus is an option" (Tablet Computer, n.d.).

Next, some examples of studies on what was considered a large-scale deployment of tablet computers in different scenarios during the last decade will be presented. Notice that none of them reached the same deployment scale involved in this study neither was their focus on the deployment process. Instead, their primary focus was on the results of the use of tablet computers in class and the perceptions of the students about the use of such devices.

Virginia Tech College of Engineering. An initial search of the literature on tablet computer deployment revealed a study by Tront (2007) including the pertinent term "large scale." This study was done at Virginia Tech College of Engineering, the first public school of engineering to require all 1,400 incoming students to own a tablet computer as of 2007 (Tront, 2007, p 62). Innovative initiatives always have been an outstanding feature of the college, especially regarding the use of gadgets and devices (Tront, 2007, pp. 36-37).

Virginia Tech College of Engineering was the first North American public institution to require all entering engineering freshmen to own a personal computer in 1984. This academic equipment requirement had been upgraded to a multimedia computer by 1996, and it had been upgraded again to a laptop by 2002. The instructors had the advantage of using software such as PowerPoint and Classroom Presenter, to improve their presentations, bring the real world to the media projectors and make notes on the already prepared presentations. Besides getting the attention of the student in the classroom in a better way, it allowed the student to take home the instructor's presentations and the in-class annotations for review and study. The interactivity in

and outside the classroom had improved since the students could participate in polls taken after the tablet-based presentation. Attendance was increased since the lectures became more interesting for the students (Tront, 2007, p. 63).

Tront observes that the tablet computer offers a more natural way of comprehensive and easy-to-use note taking and sketching for local and remote collaboration than the notebook (2007, p. 64). Thus, the instructors could present slides with diagrams, pictures, web page clippings, and equations, among other electronic materials. Moreover, during the presentation, they could add or change presentation elements, make annotations and sketches with e-ink resources (Tront, 2007, p. 65).

Furthermore, the students could submit their homework in a much more flexible way rather than using computers or notebooks. They could easily submit not only a text but also sketches intermingled with text along with the occasional picture (Tront, 2007, p. 66). Due to the outcomes resulted from the use of tablet computers, Virginia Tech College of Engineering was able to put into practice three key pedagogical concepts: increasing the active learning with the interactivity between instructor-content-students, incorporating collaborative exercises into the learning process and improving the collection, search and review of notes (Tront, 2007, p. 64).

Ubiquitous access to tablet computers in an American high school. Sommerich, Ward, Sikdar, Payne, & Herman (2007) presented research results regarding the use of tablet computers by 106 students in high school, the same education level that is the focus of this research. The study was performed considering the aspects of visual and physical discomfort, temporal and task-driven from tablet computer use. To do so, Sommerich et al. collected information from the students via questionnaires and monitoring software (2007). The results were very diverse since the students were queried about several aspects of the routine use of

tablet computers. Almost all the students declared that they had used the tablet computer on a daily basis, or nearly so. The main tasks performed with the use of tablet computers were writing or typing notes, typing papers, besides accessing class notes and the Internet. Overall, tablet computers were used in a wider variety of tasks than other resources, such as desktop computers and notebooks. When a list of fifteen education tasks was introduced to the students, more than half of them reported using the tablet computers for thirteen tasks from the list, compared to three or four tasks when the students used other resources.

The students answered positively to an extensive query on their attitudes and perceptions about the use of tablet computer. They reported some hardware problems and physical discomfort during their use. The hardware problems were mostly related to battery life and device malfunction. The physical discomforts were mostly associated with pain on eyes, neck, head, hands and backs, which is mostly related to the weight of the equipment. Its weight was 1.8 Kg, which is almost three times the weight of current tablet computers.

However, these problems did not seem to have been affecting the successful use of the equipment. The students had a positive impression of using a tablet computer, even outside of school. In the school routine, the students affirmed that the tablet computer helped them to feel more comfortable in class. Moreover, the devices made it easier to enjoy the class, to access previous lectures, to take notes during class, and to organize the class notes.

Distributed learning at Georgia Tech Savannah. In another study, Moore et al., (2008) described the use of tablet computers as improving the student learning in the distributed learning (DL) environment of Georgia Tech Savannah (GTS). The use of such a paradigm was instrumental in distributing recorded video content and promoting video conferences among 52 students and their respective instructors through tablet computers and notebooks. The use of

tablet computers and its mobility feature made possible other learning activities beyond those of traditional DL resources, such as interactive assessments and electronic note taking.

Moore et al. assumed that the use of tablet computers in educational processes "should provide active learning environments in which the cycle of knowledge transfer between instructor and student involves feedback to correct misconceptions and promote student learning" (2008). Thus, the study compared the differences between a group of students that used tablet computers to enhance their DL and the other, which just had access to traditional DL paradigm, based on video conferencing.

Moore et al. (2008) concluded that, regarding student participation (the initiative of making and answering questions during the class); there was no outstanding difference between the two groups. The same findings, applied to the student performance in distributed learning classes, resulted in only a slightly better performance for those students that used tablet computers in DL, compared to those that did not use DL through tablet computers (Moore et al., 2008, p. 110)

However, the research results showed that there was a significant difference between the two groups of students when considering the student attitudes on the use of tablet computers in DL. Those students that used tablet computers expressed a better perception of DL regarding lecture delivery, instructor interaction with students, ability to participate in the learning process, and following the lecture.

Moore et al. (2008) concluded that “although overall results confirm that there is a significant advantage of using tablet computers in DL regarding the student's attitudes, there is also a great influence by the teacher adherence to the paradigm.” Even with the hardware and physical structure to promote distributed learning through tablet computers, some teachers

simply did not use such resources. According to Moore et al., this demonstrates that the tablet computer project attained its goal of providing the freedom of choice for students and teachers regarding the hardware used for interactions, either through tablet computers or notebooks and desktop computers (2008, p. 111).

These studies brought important ideas on what must be investigated regarding technology adoption and its influence on the learning environment and on the people: behaviour change, user perceptions, learning outcomes achieved and factors that are determinant for technology adoption. Unfortunately, these studies differ in significant ways from the parameters of the study presented here since they focus predominantly on the use of tablet computers, not on the deployment processes of such devices in schools. In these studies, mentioned above, teachers and students could use tablet computers individually, whereas in most of the schools involved in this study only the instructor had a tablet computer to in the classroom. Another significant area of difference is the scale of the studies discussed above is lower than 1400 users; compared to the much larger scale deployment that is the subject of this study. The next section presents the literature review on a large-scale tablet computer deployment, which was started with the advent of the iPad (Neves & Cardoso, 2013).

The research in iPad era

Regarding scale, only after 2010, with the launch of Apple's tablet computer, known as iPad, tablet computers started occupying an outstanding position in the computer device market share (Neves & Cardoso, 2013). Its light weight simplicity of use afforded by an integration between hardware and specialized software, more sophisticated touch screen technology, improved battery life and a more affordable price, made the iPad an immediate success in various segments of the market, including the educational segment (Tanous, 2013; Huimin,

2011). Until then, the use of tablet computers in schools was restricted to some specific cases that innovation and experimentation were the main motivations for such initiatives.

As a result, some of the paradigms established in previous studies to 2010 were changed. The current tablet computer is not just an ordinary notebook with the addition of touch screen and e-ink software, as stated by Moore et al. (2008). Modern tablet computers have their hardware seamlessly integrated with the software, which is developed specifically for this sort of equipment. This integration optimizes the processing of information and the battery life, besides providing physical comfort for its use.

As tablet computers became cheaper, more portable (lighter devices), designed for diversity of models, and with high-quality hardware and software, they started being used by students both at school and at home (Clarke & Svanaes, 2012, p. 5). However, any search made in any scientific journal, or even on Google Scholar, reveals that the vast majority of the studies carried out after the emergence of the new generation of tablet computers have kept the same focus described in the previous section. This means that methods for using a small number of tablet computers in education and the their users' perceptions are the main concerns of the scholars in the iPad era (Valstad 2010; 2011; Donaldson, 2011; Clarke & Svanaes, 2012; Bogart, 2012; Pamuk, Çakır, Ergun, Yılmaz & Ayas, 2013; Dündara & Akçayırb, 2014; Wang & Huang, 2015; Li, Yuen, & Zou, 2015).

Few exceptions were found in the literature. One of them was a book published by the Commonwealth of Learning (COL), which reports the main ongoing large-scale government-supported initiatives to distribute tablet devices to students from K-12 schooling sector (Tamim, Borokhovski, Pickup & Bernard, 2015). The research was based on the literature search, which led to information about tablet computer initiatives supported by governments on all continents.

According to Tamim et al. (2015), there are 11 large government initiatives officially documented, involving a range from 3,000 to 1.2 million mobile devices.

It is important to notice that most of the publications that underpinned Tamim et al. (2015) were published between 2011 and 2013, which was the same period in which this literature review found most of its resources of information about large-scale tablet computer deployment. Next, there are some remarkable findings.

The Brazilian deployment was announced in 2011, which included 600,000 tablet computers and 3,700 interactive whiteboards, all of them were supposed to be deployed between late 2012 and 2014, when the project could still count on a satellite to cover some remote places in the Amazon forest, to provide Internet connectivity to that region (Savarese, 2012; Lima, 2013). These tablet computers would be distributed to teachers at first, and each Brazilian state would decide when more tablet computers would be distributed to high-school students. For instance, the Brazilian Northeast state of Paraíba planned to provide one-to-one tablet computers for their students three years after finishing the tablet computer distribution among high-school teachers (Press Department of Paraíba, 2013).

The deployment in Thailand was planned to distribute one million of tablet computers for students. It an amount of mobile devices enough to cover needs of all schools nationwide during 2012 in one-to-one deployment model (Garun, 2012; Hazarika, 2012). A similar amount of tablet computers would be provided for students of the Los Angeles Unified School District. Until late 2014, 640,000 iPads were supposed to be distributed among the second-largest school district of United States of America (Frank, 2013).

Another large-scale tablet computer deployment example is South Korea, which has been testing the use of mobile devices in schools since 2010. In 2012, the South Korean Ministry for

Education announced that all textbooks would be replaced by iPads, after spending around 2.4 billion US$ by 2015 (Clarke & Svanaes, 2012, p. 71). However, the largest deployment, so far, is being carried out in Turkey. The Turkish total purchase is fifteen million for tablet computers, which are supposed to be delivered to schools until 2017 at a total cost of 4.5 billion US$ (Faas, 2013).

After presenting the initial expectation at the beginning of the deployments regarding numbers of tablet computers to be deployed in different countries, the next section presents the impressions of the deployment process, detailing the actual numbers of devices achieved by the government-supported initiatives. It gives an idea of how difficult it is to deal with hundreds of thousands or millions of devices to be distributed in a relatively short period.

The first impressions of the tablet computer initiatives

A sign that there was something to be investigated was the fact that there were divergences among references published over the period of the tablet computer deployment. As it is a process that involves a huge number of mobile devices, it takes some months or years to execute what is planned and announced. When comparing the references at the beginning of the deployment initiatives (2011-2013) with the most recent ones (2013-2015), the literature review reveals some possible problems in regards to the deployment process. Some inconsistencies were identified in the published numbers. At large, the actual number of deployed devices is much smaller than what was initially announced. Furthermore, the literature demonstrates that several issues have been identified along with this one.

In the Turkish project, for instance, only 732,000 tablet computers reached the schools by mid-2014, out of the15 million units that were supposed to be distributed between 2013 and 2017 (Daily Sabah, 2014; Faas, 2013). Moreover, there were complaints about some practical

problems, such as the lack of Interne*t connectivity, insufficient electrical outlets for recharging the devices, inappropriate content, and incompatibility between tablet computers and interactive smart boards (Today's Zaman, 2015). Furthermore, the lack of transparency in the amount of money expended on the project raised suspicion of corruption in its procurement process (Today's Zaman, 2015).

The Thailand deployment, which was supposed to distribute 860,000 tablets in 2012 (Garun, 2012; Hazarica, 2012), faced problems related to hardware quality in 2013 when an audit found out that 30% of the tablet computers bought in the previous year presented some hardware problems (Sakawee, 2013). In fact, it was noticed that controlling the service and product quality of so many providers was another unexpected challenge for the Thai government (Sakawee, 2014). As a consequence, in 2014, one of the hardware providers for the initiative cancelled the deal with the Thai government (Sakawee, 2014). Viriyapong and Harfield (2013) reported some difficulties with the Thai project such as offering teacher support, ensuring usability, providing contextualized content, and assessing learning outcomes.

Even in the case of the Los Angeles Unified School District, which was supposed to distribute 640,000 iPads among students, they had to halt the deployment one year after it started due to several problems. Among the list of problems, Kastrenakes mentions the lack of appropriate content and curriculum for tablet computers, difficulty adopting the mobile devices by students and teachers, and problems with infrastructure (2014). Moreover, there were problems related to the use of the tablet computer itself. Some iPads were hacked by the students, and the school district lost control over the use of those devices, which could now be used for any purpose since the students could have installed any application software (Kastrenakes, 2014).

After depicting the first impression of the government-supported tablet-computer deployment in different countries around the world, the next section does the same for the Brazilian case specifically.

The first impressions of the tablet computer initiatives in Brazil

The Brazilian deployment was initially supposed to distribute 600,000 tablet computers between 2012 and 2014 (Savarese, 2012; Lima, 2013). However, Tamim et al. (2015) report that only 470,000 mobile devices were deployed during this period. Furthermore, the first studies on the use of tablet computers within the Brazilian government initiative demonstrated that there were some challenges to overcome. Neves & Cardoso (2013) published a study on the first phase of the deployment of tablet computers in the Federal District, located in the Brazilian capital, Brasília. Some findings indicated possible problems with the deployment:

1) Only 1,900 tablet computers were requested and taken by the teachers, out of 3,000 devices available for use.

2) From the 1900 tablet computers taken by teachers, 240 units were returned to the school administration, 100 of them because of technical problems and 140 without any justification.

3) On the first day of training on how to use the mobile devices, of which the teachers could voluntarily participate, less than half of the 3051 vacancies were filled.

4) More than half of the enrolled trainees dropped out of the four-module training course while taking the first module. Neves & Cardoso state that the main reason for such dropout rate was the method used in the training course which was comprised of around 70% on distance education (2013, p. 4). According to Neves & Cardoso, the trainees should have a higher percentage of the training time than in face-to-face activities since they are digital immigrant teachers who are 30 years old or more (2013, p. 14).

Neves & Cardoso (2013, pp. 19-20) concluded that the use of tablet computers in high school in the Federal District depended on some factors, such as logistic adjustments in the way that the devices were distributed concomitantly to the training phase, adequate school infrastructure to support the use of the tablet computers, and quality of the mobile devices used in the project. Furthermore, the education policymakers must consider the barrier of generation differences. The current teachers are digital immigrants. Thus, they need to be prepared to adapt to the new way of acquisition and flow of knowledge (Neves & Cardoso, 2013).

Brito (2013) corroborates the view of Neves and Cardoso (2013) with respect to the migration to the digital world, by splitting the teacher's technological learning into four different phases. In the pre-phase the teachers use the tablet computer for personal and professional use, including access to social media, cloud storage, e-books, and content search. The first phase is the one in which the teachers use the mobile device to improve their classes, by presenting digital content in the classroom, and distributing educational materials and activities through the Internet. In the second phase, the teachers perform partial changes in their pedagogical actions, expanding the teaching strategy beyond the classroom with the use of blogs on social network communities, establishing communication with the students through social media, and creating new forms of assessment. The third phase demands curriculum flexibility to allow the teachers to innovate their teaching methods according to the technology available to them. Expecting the teachers to go from the pre-phase to the second or third phase within a few months of training is a mistake which can compromise the deployment process as a whole.

Oliveira (2014) also indicated the infrastructure as one of the main problems reported by the teachers and students for using the tablet computers in Recife, Northeast of Brazil. There was a lack of electrical outlets to recharge the mobile devices and insufficient or no Internet

connectivity (Oliveira, 2014, pp. 5-6). Moreover, the fact that the Internet can break the barriers of space and time was not noticed by most of the teachers that were interviewed (Oliveira, 2014, pp. 6-7). There is an expectation on the part of the students in regards to the expansion of communication and educational resources with the use of the Internet and mobile devices. However, the teachers seem not to be prepared for such an education paradigm. Instead, they demonstrate concerns about the control over the use of mobile devices in the classroom, considering the student to be a passive subject in the learning process (Oliveira, 2014, pp. 7-8). The use of tablet computers in the classroom ends up being mostly for searches on the Internet and some note taking by the students (Oliveira, 2014, pp. 8-10).

In a study performed by Nascimento (2014) in the state of Paraiba, also in Northeast of Brazil, the findings are similar to the other studies but expressed in a more assertive way. Nascimento (2014) states that the schools are not prepared to receive the tablet computer or other educational technologies that support the mobile devices, especially poor Internet connection. The teachers and students are not prepared to use the mobile devices pedagogically, and the management staff needs to be aware of the potential use of tablet computers for the education process they manage.

Similar findings to those presented in this section can be found in other references about the use of tablet computers in public high schools in Brazil (Araújo & Ribeiro, 2014; Lucas, 2014; Souza, 2014). As the literature indicates, there are repetitions in the findings of these studies performed in different states of Brazil. All of them focus on the impressions about the tablet computers in the public high-school education processes. However, there is no mention of the deployment process as a whole, and the different aspects to be considered when dealing with a large-scale deployment of any technology for educational purposes. Thus, the next section is

dedicated to identifying the main factors to be considered in a large-scale tablet computer deployment.

Large-Scale Adoption Models of Technology in Education

Although there is a lack of studies on the large-scale implementation of tablet computers in education (McGee and VanderNoor, 2013, p. 12), there are some studies that focused on models of high-scale deployment of technology. Some different approaches related to the subject of this study are shown below. They are important to confirm that the initial presumptions regarding the factors that are being considered in a high-scale tablet computer deployment are correct.

Hall and Khan (2002) use the term dissemination instead of deployment since they consider the adoption of new generic technology by ordinary users, extrapolating the educational context of technology adoption. They differentiate between invention and dissemination of new technology, whatever the context involved, including the educational scenario. They state that the invention of new technology "often appears to occur as a single event or jump." Rather, the dissemination of new technology appears as a continuous and slow process. It is important to understand that the educational sector, which is the focus of this study, aims to improve the learning outcomes with the deployment of tablet computers. Hall and Khan advocate that the pace of this educational evolution regarding learning outcomes and teaching productivity be determined by the dissemination of the technology (2002).

Adopting new technology can be seen as the result of a sequence of individual calculations that weigh the incremental benefits brought by it (Hall and Khan, 2002). Normally, adopting new technology starts slowly, at first, accelerating as it spreads throughout the potential adopters. In the case of this study, the adoption of tablet computers takes place among teachers

of public schools throughout Brazil. As long as the teachers that are able and interested in using the tablet computers adhere to the new technology, the procedure slows down since the defined population becomes saturated (Hall and Khan, 2002, p. 5).

In fact, Hall and Khan (2002) present an adoption model called learning or epidemic model, which considers that the technology consumers (the public school teachers) have identical opinions on the technology but not all of them are informed about the technology at the same time. There is a similarity of this situation with the Brazilian deployment because not all teachers make part of the deployment at the same time, and they have the freedom about whether to use the tablet computers or not. As time passes, the new adopters show the benefits of using the new technology, which makes the others that have not been using it yet want to adopt the new technology. First, in this context, the study implies that the first teachers that use the tablet computers demonstrate to the others the advantages of using such technology, stimulating them to use it as well. The adoption curve becomes steep until most of all the potential users adopt the technology, that is, the technology adoption has reached the saturation point.

The technology adoption model indicates that the time that is taken for adopting new technology varies accordingly to the value perceived by potential users for adopting the new approach (Kotrlik and Redmann, 2009, p. 45). That is, the teacher will accept to use the tablet computer earlier if there is the perception of advantage or value in doing so. Fullan (2001) states that when the adoption of new technologies happens between teachers, it occurs in three stages:

- Stage 1: Adoption of the new technology, or accepting to use the tablet computer in our study context.
- Stage 2: Implementation of the new technology, or overcoming the barriers to using the tablet computer effectively. It involves curriculum planning, content development, and class preparation.
- Stage 3: Continuation or using what was prepared to use during the classes and effectively get the results of the tablet computer adoption.

Moreover, Fullan (2001) states that teachers need some time to merge the improved knowledge of the new technology into the instructional practice in the classroom. Further, having this time for merging is important for the teacher to accept the innovation.

In fact, Kotrlik and Redmann (2009) states that the lack of time for merging improved knowledge into instructional practice is only one out of a few barriers to technology adoption. They also mention the lack of the necessary knowledge to learn and the lack of self-confidence in using technology, especially in an environment in which the students likely master the use of mobile devices more than the teachers. Park and Ertmer (2008) also mention additional barriers, such as " . . . a lack of a clear, shared vision as the primary barrier. Additional barriers included lack of knowledge and skills, unclear expectations, and insufficient feedback" (p. 631).

The models described so far are partially useful for this study context since Hall and Khan (2002) do not focus on technology adoption specifically in the educational context. Furthermore, Kotrlik and Redmann (2009), Fullan (2001), and Park and Ertmer (2008) concentrate their efforts on the perceptions of the teacher regarding the technology issues: value perception, knowledge, expectations, training, and feedback.

The government initiatives for improving the educational processes involve much more than technology adoption by the teachers involved. The model that represents these initiatives must optimize the investment return on the technology involved. In doing so, the usage of the technology must be maximized as long as the average cost of deploying decreases as an organization leverages technology investments, infrastructure, support and training time (Greenberg, 2012, p. 4).

The deployment model must consider the issue of scalability, i.e., "the ability of a system, network, or process, to handle growing amounts of work in a graceful manner or its ability to easily to adapt to accommodate that growth" (Greenberg, 2012, p. 5). The deployment process is influenced by some factors that generate a set of questions related to the study context (Greenberg, 2012):

- Deployment method - What technology should be used among the existing options? Who will be the provider that should be hired?
- Staffing - Who will be responsible for making everything work perfectly? How much staff and time will the deployment require?
- Instructor resistance - What will be done to make the teachers accept the new and novel? What policies will ensure technology adoption?
- Expectations - Is the new technology going to improve the learning outcomes? What metrics should be used to evaluate the efficacy of using the technology?

In order to respond to all of these questions, the model proposed by Bassi (2010) demonstrates adequately several key elements in a deployment of educational technology, as it is shown in Figure 1. Bassi (2010) has identified several key elements that must be considered to

attain a meaningful impact of technology in an educational context. She states that "these components must co-exist; none are optional" (Bassi, 2010, p. 5).

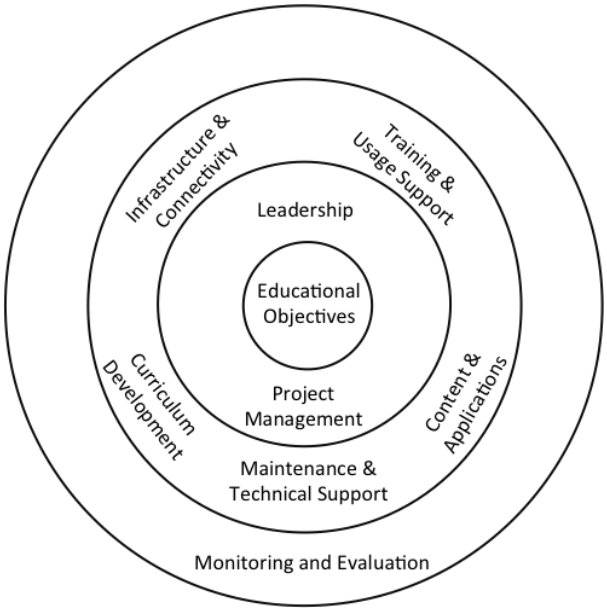


Figure 1. Model for large-scale technology deployment (Bassi, 2010). This illustrates the main factors to be considered in a large-scale deployment of technology in an educational context.

Based on the educational objectives for which the deployment was planned, the leaders drive the deployment process, especially based on project management. The components of the implementation process are discussed in this section, together with other elements identified as being important in the specific context of the use of tablet computers in schools. Monitoring and evaluation must surround all the elements, in order to allow corrections in the implementation.

At this point, it is important to notice that the Brazilian deployment does not follow this model. There is no reference that mentioned the existence of specific educational objectives. There is no standardization in regards to project management techniques to be used by the regional and local leaders to manage the deployment process in their respective states or cities. There is no public information about any monitoring and evaluation procedures that have been

taking place by the deployment managers. The only information regarding evaluation that is found publically is related to research studies like this one, led by independent researchers.

Factors to be considered in a large-scale tablet computer deployment

Most of the studies found for this area of research were centered on the impressions of teachers and students on the use of tablet computers in schools. Little literature focuses on the large-scale deployment of educational technology. One exception is the study of Bassi (2010), which focuses on guidelines for the pilot project and large-scale deployment of technology for education. This work helped to build a list of some important factors to be considered in the educational context of this study. The main factors, but not the only ones, considered in this work for a large-scale tablet computer deployment in high-school education systems are presented below.

Logistics. The literature reviewed for this work makes little mention of the logistics involved in tablet computer deployments. The only reference is found in studies involving large-scale operations (Faas, 2013; Weis, 2013; Hazarika, 2012).

Logistics is a factor that involves not only the supply of devices for the school, but also how the equipment will be stored and handled in these environments, as well as the model of ownership. The provision of some hundreds of tablet computers is something that can be handled with a retailer. However, when the deployment involves hundreds of thousands of devices, because of logistics and cost issues, the procurement must be negotiated directly with the tablet computer manufacturer.

To illustrate this issue, consider the case in Turkey, which involved 15 million devices to be delivered to 40,000 Turkish schools over four years. "That means 10,000 deployments will be happening simultaneously each year over the four-year time frame" (Faas, 2013, para. 11). Any

issue involving this logistical plan can incur several consequences for the rest of the deployment, affecting training, pedagogical plans, content production or specification and, hence, the learning outcomes within the project plan.

Even when disregarding the initial mobile device delivery, there are other issues to consider. Who will be the owner of each tablet computer used in the education process? Burden, Hopkins, Male, Martin and Trala (2012, p. 52) state that when the approach used is BYOD (Bring Your Own Device), the user has more motivation and interest. Further, the BYOD approach still transfers many of the logistical problems to the user, besides increasing the cost by 25-30% of the required infrastructure, according to Dixon and Tiemey (2012), as cited in Handal, Ritter & Marcovitz (2013, p. 789). However, this has not been the case in Brazil, in which most initiatives have been government-supported, where the devices have been bought centrally by the government and distributed to the teachers.

Furthermore, logistics is directly related to another important aspect: technical support. When there are problems with a device, are there any spare tablet computers for immediate replacement? If not, how long does it take to send the broken device for repair? How are the devices shipped to be repaired? Thus, it is important to investigate how these logistics are supposed to work, as well as if and how it will influence the pedagogical results. The teachers do not need to understand logistics to provide important information on this issue; they just need to report their pedagogical and operational problems, which could have originated from this aspect of the deployment process.

Training. Educators need to become aware of how to develop a digital pedagogy, based on the use of tablet computers (Bogart, 2012). Unfortunately, in general, high-school teachers do not have an understanding of the differences inherent in the traditional learning and the tablet

computer based learning (Bogart, 2012, p. 70). Also, Brazilian high-school teachers usually are not as digitally inclined as their students (Veja, 2012), which means a great barrier to teacher adherence to the use of tablet computers in classroom.

The education resulting from the use of tablet computers must be in accordance with the 21st-century critical skills for education: critical thinking and problem solving; collaboration across networks; agility and adaptability; initiative; effective oral and written communication; and accessing and analyzing information (Wagner, 2011). Valstad goes even further when he states that the way in which digital pedagogy should be put into practice is to use information and communication technology at the skill level of the student, not that of the teacher (2010).

Teachers must be trained to the use of the equipment to optimize the use of tablet computers. Further, they have to master the process of integrating the utilization of the device into the course program, in a way that they can achieve the skills mentioned above. This approach reduces the underuse of available technological resources, such as those mentioned by Moore et al. (2008), in which the instructors had all the equipment to implement distributed learning through tablet computers, but some of them simply ignored the technological resources.

In fact, training is so important that Tront (2007) stated that it was central to the success of the tablet computer initiative in Virginia Tech College of Engineering. Teachers needed extensive training not only to enable them to use the devices effectively, but also to take part in the production of optimized educational content compatible with the technology available. Moreover, Donovan and Struder (2007) observed that when teachers and students are concurrent in the learning of the use of technology, it reduces the assistance provided by the teachers for the students. "Teacher confidence determines the manner in which he delivers to the students" (McGee & VanderNoor, 2013, p. 11).

In the case of the Brazilian deployment, the research done about the teacher's impressions over the government-supported initiative demonstrates that training is a recurrent issue. The training provided to the high-school teachers involved with the use of tablet computers has been considered insufficient or inadequate to provide the proper skills for them to use the available technology in their classes (Neves & Cardoso, 2013; Brito, 2013; Oliveira, 2014; Nascimento, 2014; Araújo & Ribeiro, 2014; Lucas, 2014; Souza, 2014).

Infrastructure. Infrastructure refers to the physical support for the use of the mobile devices in the schools. It leads the total cost of a large-scale deployment and is more complex than it seems to be since it does not only involve the cost of the mobile devices itself. A tablet computer deployment in a school demands some extra cost related to, but not limited to, the items below (Sommerrich, 2007; Rock, 2012; McGee & VanderNoor, 2013).

1) Installation or improvement of Internet connectivity.
2) Electrical installation expansions to allow for device battery recharge.
3) Interactive whiteboards, projectors and big screen televisions.
4) Computers and software to support authoring activities.
5) Furniture needed to be adequately installed to use the equipment mentioned above.

Bogart (2012, p. 61) states that although the deployment of tablet computers is an important initiative for Thailand, nobody can ignore the digital divide created by the lack of proper infrastructure in 2000 schools. This problem derives from a lack of adequate facilities and electricity. This issue must be solved before the tablet computers arrive. The wired network of a school also needs to be expanded, upgraded, and redesigned to support and manage the network load that the devices will generate (Faas, 2013). "Robust connectivity and school-wide access to

Wi-Fi are essential and should ideally be in place before mobile computing devices are deployed" (Burden, 2012, p. 13).

Unfortunately, according to the recent studies performed in different states in Brazil, there is a lack of adequate infrastructure to accommodate the use of tablet computers. Even the most fundamental prerequisites for a decent deployment (Internet connectivity and electrical outlets) are not met (Oliveira, 2014; Nascimento, 2014; Araújo & Ribeiro, 2014; Lucas, 2014; Souza, 2014).

Maintenance and device replacement. When dealing with a large number of electronic devices in an educational process, there is always a percentage of device breakage, which can be a problem for the teaching process. Clarke & Svanaes (2012) state that the average tablet computer breakage rate in his research in the United Kingdom hovers between 5% and 8% of the total number of tablet computers introduced into the school routine. In the deployment done in Thailand, there are estimates that this rate reaches 30% for the first year of use of the devices (Sakawee, 2013).

Aside from the breakage rate, the devices are also at risk of being lost or even stolen. "Security risk is a major challenge to students using the devices since they are an easy target by gangsters" (McGee & VanderNoor, 2013, p. 10). However, there is little information about what could be done with this kind of issue in large-scale tablet computer deployments around the world. This is particularly an important issue in the Brazilian context since Brazil is the fifth most violent country in the world in regards to robbery, which includes muggings and theft with violence (Knoema, 2014).

Bassi (2010) proposes a replacement plan, which would entail that the device is exchanged in case of hardware failure. Clarke & Svanaes (2012) suggest the use of insurance to

cover unexpected hardware problems and device losses or even theft. However, neither of the solutions for equipment replacement was found in this literature review for the Brazilian case.

It is important to realize how impactful the issue of hardware failure is for the effectiveness of the education paradigm regarding learning outcome improvement. If there is no efficient way to replace the broken, lost or stolen devices, the teacher will face severe problems teaching since everything was planned and relied on the use of the tablet computer. One aim of this study is to study how the Brazilian schools deal with this issue and what has been done in these kinds of situations.

Content. Content has been an important element in achieving the desired improvement in learning outcomes in the Brazilian operation with tablet computers. This aspect was planned before the purchasing of the devices. The federal government created the Portal do Professor (Teacher's Portal, http://portaldoprofessor.mec.gov.br), with open educational resources (OER) available for free use by the teachers. Most of its 15,000 OERs were created by public universities or by volunteer teachers across the country. The portal also relies on all the lectures of the Khan Academy on Mathematics, Chemistry, Biology and Physics, which are totally localized (translated and interpreted with cultural adaptation) to Brazilian Portuguese (Honorato, 2012). This portal works similarly to OpenCourseWare, the Massachusetts Institute of Technology (MIT) initiative that counts on more than one hundred partners across the globe (Caswell, 2008, p. 3). The portal is more than an OER repository in that it allows teachers to attend online courses to improve their teaching techniques, to interact with each other to share pedagogical experiences. In addition, this portal enables teachers to request methodological help and content (Portal do Professor, 2 013). Furthermore, the sponsor of the portal is the federal government, and all the content available is in the public domain.

The teachers are able to use the resources available which are closely related to the training activities provided, as long as they receive the tablet computers. Since the teachers are supposed to be trained methodologically and technologically to use the tablet computers for teaching, they would be able to adapt the content available in the portal and on the Internet to their respective teaching contexts (Honorato, 2012). However, no further information was found regarding the way the teachers involved in the Brazilian deployment manage the use of content in their respective courses.

Support. Bassi (2010, p. 23) considers support as a key factor in the success of a large-scale deployment of educational technology. The author suggests some basic resources, such as self-assisted guides, local or regional support, and a toll-free central support phone number. Thus, the teachers can feel more confident in overcoming technical and operational difficulties in the day-to-day use of the technology for their classes. Lucas (2014, p. 23), Souza (2014), and Honorato (2012, para. 2) state that the support provided for the Brazilian deployment is not enough. There is a necessity of pedagogical support besides the technical support provided. After all, only mastering the technical use of the mobile device does not enable the teacher to use it in his/her teaching context.

Student reaction and learning outcomes. As presented earlier, research on the student reaction and the learning outcomes achieved by students is the most frequent type of study found in the literature (Tutty, 2005; Sommerich, 2007; Tront, 2007; Donaldson, 2011). For instance, Bogart (2012) states that the tablet computer prevents boredom with learning and improved the student's skills in either playing games or solving simple problems. In another example, Clarke and Svanaes (2012, p. 20) make observations about the parental engagement and the potential for distraction with the utilization of tablet computers in the education process. However, notice that

these studies rely on the fact that each student had their tablet computer in a one-to-one environment.

Therefore, the particularity of this study lies in the fact that the Brazilian case focused on the instructor only having use of a tablet computer, whereas in the literature reviewed to date most of the focus was on the use of tablet computers not only by teachers but also by students as well. Also, as this study focused on the participant responses, any information about student reaction was based on the teacher's perception, and did not involve collecting data directly from their students. The same for the learning outcomes; then, any information about scores or learning behaviour was obtained from the teacher's perspective.

Besides the factors listed so far, Bassi (2010) adds others, such as standardized equipment, the complete inventory of all resources available, and preceding the deployment in stages, overlapping the individual stages at different sites. It is important to consider that the factors listed in this section are likely candidates to be categories of the Grounded Theory implementation, during the research analysis. Thus, the additional factors suggested by Bassi will be detailed just in case the data collected indicates that they are significant for the results of this study.

Chapter 2 Conclusion

Because of the very specific scenario of tablet computer deployment in public schools in Brazil, the literature review done to date covers the matter only partially. McGee and VanderNoor (2013) state that the lack of studies on large-scale tablet computer deployment processes in schools does not only apply to the case in Brazil, but to others as well.

The first and biggest weakness is a lack of researchers who have handled the subject. Another major challenge for the current research is a lack of focus on the implementation

process. Many researchers have avoided the subject of implementation and have focused on the emerging issues of the adoption of the devices in schools. The research on the subject has been based only on a few schools and, therefore, lack a global view (McGee and VanderNoor, 2013, p. 12).

Further investigation is, therefore, necessary, with the expansion of search parameters, involving references such as the Bassi (2010) study, which presents recommendations for education technology without specifying any. Researching deeper on the optimization of the deployment process of tablet computers on a large scale constitutes an important contribution to those involved in tablet computer deployment for countries, states, provinces and school districts. The regular use of such devices on a large scale around the world is just a matter of time, according to Rock (2012). The education sector is projected to spend more than 100 billion US$ in the mobile-device-based education by 2020 (Rock, 2012).

Chapter 3 presents the methodology and procedures used in this research study. Data gathering, quality assessment, coding, and analysis methods for this thematic synthesis are discussed in the next chapter, as are ethical considerations, study feasibility, research limitations, study outcomes, and a projected timeline.

Chapter 3

RESEARCH METHODOLOGY

This study is based on the Strauss approach for Grounded Theory (Corbin & Strauss, 2008). Thus, the chapter starts with the presentation of the study scenario to justify the choice for Grounded Theory as the research methodology for this study. Therefore, the fundamentals of Grounded Theory are introduced to give a broad vision of this theoretical framework in the research context. After, this chapter describes some research methodology alternatives for Grounded Theory and explains why they have not been chosen for this study.

The Study Scenario

The study scenario presented in the introduction of this study is unusual. Having hundreds of thousands of tablet computers to be deployed among tens of thousands of schools throughout a large country is not a common initiative and most times this is supported by governments. In fact, this is the result of very recent social and technological conditions since the popularization of tablet computer use erupted only after 2010, as well as its large-scale sales (Neves & Cardoso, 2013).

Moreover, the above-mentioned study scenario highlights the absence of studies focused on the tablet computer deployment process (McGee & VanderNoor, 2013, p. 12). Thus, there is little or no information about its main elements, processes, and factors that influence the outcomes obtained from the deployment of this new education paradigm on a large scale. Only a few studies that were recently published focused on the perceptions of teachers and students on the use of tablet computers in the classroom within the Brazilian government-supported initiative (Oliveira, 2014; Nascimento, 2014; Araújo & Ribeiro, 2014; Lucas, 2014; Souza, 2014).

However, none of these studies had the approach of analyzing the implementation. Also, these studies were drawn to explore the use of mobile devices on a small-scale. Moreover, they involved only one school without considering the actions and the structures of the education administration at the district level.

The variables involved in a large-scale tablet computer deployment are several, such as logistics, training, human resources, support, and infrastructure (Bassi, 2010). In addition, the context of the deployment has an important influence on the perceptions of the different stakeholders, such as teachers, students, educational policymakers, and managers. Therefore, since there is no previous structured framework theory or absolute assumptions that could firmly support a hypothesis, Grounded Theory was chosen as the research methodology for this study. The following sections justify this choice.

Qualitative Research

According to Vergara (1997), qualitative research allows the researcher to study the social realities through the comprehension and interpretation of the human signals and their processes of social constructions. In order to do that, Godoy (1998) explains that the researcher goes to the research field to understand the phenomenon from its context, in a way that it is possible to understand its dynamics. Mianyo (1993) states that qualitative research aims to answer questions whose responses cannot be quantified. It happens when working with signs, reasoning, aspirations, values, and attitudes related to a deeper perception of the relationships, of the processes, and of the phenomena that cannot be quantified (Pacheco, 2010).

When using qualitative methods, the researcher can obtain information that is very difficult to access through quantitative methods, such as feelings, thoughts, and emotions (Corbin & Strauss, 2008, p. 24). As the phenomenon that is the object of study in this research

involves several variables, feeling, opinions, perceptions, the use of qualitative methodology is selected for the case (Pacheco, 2010).

In a large-scale deployment of tablet computers in public schools in Brazil, the social reality is not concrete; rather, it is the result of the subjective experience of the individuals. Therefore, to understand the studied phenomenon it is fundamental to have the standpoint of the individuals involved, instead of the observers, which leads to an interpretivist paradigm (Rissi, 2013, p. 138).

Furthermore, Morgan (2007) states that when the subject of a study has a doubtful ontologic status, the best option is choosing the interpretative epistemology. Therefore, this study assumes that an order and an implicit standard in the social world, arising from intentional actions of people, individually or in harmony with each other (Rossi, 2013, p. 77), needs to be interpreted to be understood.

Since we have such a reality in this research scenario, Grounded Theory comes with a good option to underpin the study. The reality that needs to be interpreted in order to be understood in this work is constructed by all the stakeholders involved in the Brazilian large-scale deployment of tablet computers in public high schools. "Those that address Grounded Theory share the belief of abandonment on the existence of truth about external reality that can be discovered, valuing the contextual conditions under which phenomena occur, i.e., the theory is enacted in a case where there are multiple co-actors" (Fernandes & Maia, 2001, p. 53).

Next, Grounded Theory is depicted in regards to its history and some changes and enhancements that made it a good option to underpin this study.

Grounded Theory

The first important publication about Grounded Theory was the book The Discovery of Grounded Theory, written by Glaser and Straus (1967). "The keyword here is ‘systematic,' as they advocated that data systematically obtained from the social research could result in a theory construct” (1967, p. 13).

In fact, Grounded Theory “is a method that emphasizes understanding the voice of the participant to build a theory about phenomena” (Mewborn, 2005, p. 45). At first, it implies taking an inductive approach, based on data collected from the participants and other sources of information involved in a problem that will be studied, instead of simply deducing conclusions based on a proposed hypothesis. As explained by Stern (1980), Grounded Theory is a form of field methodology, and it aims to generate theoretical constructs that explain the action in the social context of study (p. 21). The theory is built from the data that is collected and analyzed systematically and rigorously, according to the structured guidance of the researcher (Fernandes & Maia, 2001, p. 54). In this way, more than describing what happens in the research scenario, Grounded Theory helps to understand what happens there, developing an understandable explanation about the studied phenomenon. .

When using the Grounded Theory approach, the researcher does not previously establish a hypothesis that will frame the study. Instead, the researcher attempts to discover the dominant processes or concepts in the social scene through the comparison of every piece of data collected during the research study (Stern, 1980, p. 21). The researcher codes the collected data to identify themes and concepts, which are categorized and integrated, to achieve the initial theory framework. As long as the data is collected and analyzed, the data collection process may be modified by the resulting theoretical construct, since false leads are dropped and more

penetrating questions are asked as necessary (Stern, 1980, p. 21). This refining process of theoretical constructs is continuously taking place through the study until the codes obtained from the data collection start repeating systematically (Corbin & Strauss, 2018, p. 72; Bainbridge, 2013, p. 111). Finally, the outcome of the data analysis is a theory that includes the categories of data collected by the researcher (Thomas, 2006, p. 241). A more detailed description of the implementation of research based on Grounded Theory will be presented throughout this chapter.

The Grounded Theory evolved after the original approach presented by Glaser and Strauss (1967), as stated by Bainbridge (2013, p. 110). Strauss reformulated the Grounded Theory, establishing that it could be carried out not only with an inductive approach, as originally defended but also with the deductive approach. This evolution enables the researcher to relate codes to each other, the process of which is called axial coding, by creating a combination of inductive and deductive thinking (Corbin & Strauss, 2008, p. 64). In turn, Glaser remained more faithful to inductive data analysis only (Cooney, 2010). The Strauss approach "pays attention to the broader environmental and contextual factors (macro conditions) that influence the phenomenon being studied" (Cooney, 2010). Moreover, it also created clearer guidelines for data analysis than Glaser's approach. Thus, this study uses the Strauss approach of Grounded Theory as long as it is better suited to the research context than the Glaser approach.

Other Research Methodologies

It is important to mention other possible options of research methodologies that were considered for this study. Assuming that the study scenario is complex, with several variables to be considered, and the main purpose of the study is to understand the phenomenon, the

alternative options that were considered were: Phenomenology, Ethnography and Big Data combined with Grounded Theory. However, each of these options was dismissed due to the reasons noted below.

Phenomenology. The primary goal of phenomenology is to describe phenomena or to describe how the studied phenomena are interpreted (Kafle, 2011). However, phenomenology is adequate when the "task at hand is to understand an experience as it is understood by those who are having it" (Cohen, Kahn and Steeves, 2000, p. 3). This study involves more than simply getting the standpoint of those who take part of the research, we aim at interpreting their opinions. Understanding the factors that influence the process of deploying tablet computers on a large scale in public schools is more complex than simply understanding the description of the phenomenon from those who take part in it. Therefore, phenomenology does complement this study.

Ethnography. Ethnography is another option, but it is adequate when the study focuses the exploration of role, conditions, attitudes and interpersonal relationships, combined with fundamental cultural descriptions (Sarantakos, 1993, p. 268). In other words, it is useful when "the intent is to provide a detailed, in-depth description of everyday life and practice" (Hoey, 2013). However, the studied deployment not necessarily involves interpersonal relationships nor everyday life and practice. It is a deployment, involving stakeholders that will never have direct contact with each other in some cases. For instance, the educational policymaker most likely won't have direct contact with the teacher that is supposed to receive a tablet computer to use in his/her classes. Therefore, ethnography also does not apply to this study.

Big data. The last option someone could suggest for this study is the use of big data techniques to generate theories based on a huge amount of data collected from the phenomenon

context. Anderson (2008, para. 7) initially considered this approach, in a provocative article, as stated below.

> "This is a world where massive amounts of data and applied mathematics replace every other tool that might be brought to bear. Out with every theory of human behaviour, from linguistics to sociology. Forget taxonomy, ontology, and psychology. Who knows why people do what they do? The point is they do it, and we can track and measure it with unprecedented fidelity. With enough data, the numbers speak for themselves."

Since then, the Anderson's approach has grown exponentially. The use of big data has been combined with qualitative research methods, including Grounded Theory. Berent and Seidel (2014) describe how Grounded Theory methodology can be used to build a theory from big data. Regardless the model that describes the process of theorizing from big data, there is a basic prerequisite for using such an approach: large amounts of data.

As Sundquist (2013) stated, "digital technology has enabled researchers to access, store, analyze and report unprecedented massive amounts of data." From the technological point of view, the deployed tablet computers can collect data regarding its use and feed a database whose huge amount of data can be analyzed to generate scientific findings and even theories. However, there is no massive amount of data to be analyzed because there is no data collection that can take place at least during the deployment process under analysis. Thus, the consideration of big data does not fit in this study as well.

Chapter 3 Conclusion

This chapter discussed the rationale for this study, justifying the choice of Grounded Theory to underpin the research. It also presented some other potential theoretical frameworks to be used in this study, as well as the reasons why they were not chosen. The next chapter presents

how Grounded Theory was utilized in this study. The next chapter also details each stage that the researcher had to pass through to put Grounded Theory into practice to do this research, commentating on particularities related to facts and findings within each phase of the study.

Chapter 4

DESIGN AND METHODOLOGY

This chapter is dedicated to depicting the study design and followed procedures to implement this research. First, the chapter presents the purpose of this study contextualizing the research questions into the theoretical framework chosen for the study. After, the research methods used are depicted over the different steps needed to implement Grounded Theory: participant recruitment, online survey, data analysis, coding and memoing, theoretical sampling and theoretical construct. The chapter also describes the significance and the limitations of the research, as well as the feasibility issues that the researcher had to overcome to perform the research. To wrap up the chapter, the text presents the research trustworthiness and ethical considerations for this research.

Purpose of the Study

The purpose of this study is to use Grounded Theory to raise the main factors to be considered in a large-scale tablet computer deployment in school districts, depicting the relationships between the factors, as well as the order of precedence between them. It means to develop a model based on the perceptions of those who have already experimented with the deployment and use of such mobile devices in a public high-school environment. This model is supposed to describe the reality of an ideal deployment process considering the opinion of the Brazilian stakeholders. Thus, it can be applied in the real word. As a consequence, it can be used to analyze and/or to plan a large-scale deployment of tablet computers in a school district with similar features.

Research Questions

Straus and Corbin highlight that "the research question is a statement that identifies the topic area to be studied and tells the reader what there is about this particular topic that is of interest to the research" (2008, p. 26). Thus, the primary research question that this study is supposed to answer is: What are the factors to be identified in a large-scale deployment of tablet computers in a public high-school district?

Potential sub-questions and preliminary themes are provided below with a few *a priori* examples. However, as data coding was performed using an inductive, iterative approach (Allan, 2003), sub-questions and codes were not confirmed until data coding began.

1) Is there any relationship between the factors identified as being important for the deployment process? What are these relationships?
2) What elements or procedures could be added to the tablet computer deployment in high schools to improve the process and/or mitigate problems?
3) Is there a feasible model for describing these factors and their relationships that could guide a large-scale deployment of tablet computers in a high-school system?

To ensure the validity of the study, coding for themes was conducted in an emergent, iterative, and inclusive manner (Savin-Baden & Major, 2010). It was anticipated that sub-questions would also emerge in an iterative manner. Dixon-Woods, M. et al., (2006) advocated employing an iterative approach for generating research questions and sub-questions, therefore, the question(s) was(were) modified in response to search results and coding. Eakin and Mykhalovskiy (2003) elaborate on this iterative approach stating that "the research question functions more as a compass than as an anchor, and is sometimes not known until the end of the research" (p. 190).

Research Method

This research had to establish some research methods and to use some tools to implement Grounded Theory. The main research methods included an online survey, interviews performed by the researcher (by email, phone, and in person), and on-site visits. To prevent bias in the interviews, the researcher did not mention any argument on the deployment process in advance for the dialog with the interviewee, just making open questions to obtain responses related to the research questions. The use of driven questions, which mentioned specific factors and deployment contexts, was limited to the application of theoretical sampling techniques. In this case, specific questions were made to address some aspect of the deployment, to fill some possible gap in the understanding, to look for new approaches, and to consolidate categories.

The main tools were the web service Survey Monkey to collect data through an online survey and the qualitative analysis software Atlas.ti, which was fundamental in allowing the researcher to conduct the data analysis. All of the procedures to put into practice the theoretical framework presented in the last chapter are described below.

The procedures are classified into five steps: participant recruitment, online survey, analysis and coding, theoretical sampling, and theoretical construction. The Corbin & Strauss approach for Grounded Theory is mentioned in each step, accompanied by the respective literature citation and the procedures taken for this study.

Participant Recruitment

The research procedure started with the participant invitation, which brings up the concern about what exactly is the defined population to be invited to participate in the research. Ross (2005, pp. 2-3) refers to that ideal research-participant specification as being a sample composed of the desired defined population. In this case, the stakeholders involved in the

Brazilian large-scale tablet computer deployment, such as teachers, students, pedagogues, principals, support technicians, managers, scholars, and education policymakers, composed this population. Unfortunately, because of the financial and operational limitations to handle research involving dozens of thousands of stakeholders, this study needed to have its defined population for the data collection.

The Brazilian deployment allows that each participant state can establish its policy for the use of the tablet computers, including buying additional devices above and beyond those received from the 600,000 tablet computers initially announced. This means that there may be some slight variations in the way that the deployment occurs in each Brazilian state. For instance, the strategy and length of time for training the teachers in the use of the mobile devices might vary from one state to another.

Contrary to some Grounded Theory studies in which there is a very specific site to be studied, this study involves stakeholders spread out through different and distant sites. Since the users have the appropriate technological resources, this study used the Internet to reach them, with the utilization of an online survey to collect data. Thus, it is possible to check if the impressions of people with some relation to the deployment in different regions are similar and coherent, in a way that the research results can demonstrate patterns that can be used to construct a model to describe the deployment process as a whole.

Instead of looking for the support of the districts or state education department, this research had the support from the Brazilian Association for Distance Education (BADE), which is one of the most important and proactive Brazilian associations for the promotion of technology in education. Since January 2015, BADE had already confirmed their intention of releasing an invitation message from its email list with recipients from all over Brazil (Appendix A).

The sending of the invitation message was the first step in establishing the defined population. The letter of information oriented those interested in participating in the research to go to a specific web address to respond to an online survey which is presented in Appendix B. Some procedures were needed as long as the BADE email list has all kind of recipient profiles such as educational product vendors, consultants, scholars, teachers, principals, undergraduates, master and doctoral students, executives, and government representatives. Then, the letter of information made clear that only professionals with some relationship with the studied deployment should participate of the research.

The next section presents details about the online survey and the process associated with the data collection tool.

Online Survey

The online survey was the first data collection tool used in the research, and it was composed of the questions listed in Appendix C. There were different types of questions for the participants to respond to: questions about the participant's identification, about their partisan profile (personal and professional profile), and about the deployment process itself according to the participant's perceptions. The participant's identification was used for a viable raffle incentive for participation in the research: a chance to win a Samsung Galaxy tablet computer Tab 7". Moreover, the identity data (name, email, and phone) could be occasionally used to allow the researcher to contact the participant to follow up on the research methodology procedures.

The profile questions raised information about gender, age, education level, professional experience, and role in the studied deployment. They were used to try to define the average profile of the professionals related to the studied deployment. Rather, at first, they were used to

assure that the factors indicated as important for the tablet computer deployment did not have any bias caused by an exacerbated predominance of a specific profile. This profile information was used, for instance, to find out that all the responses are homogeneous if considering the different regions of Brazil, indicating that the factors pointed out by the respondents has no geographical bias.

The questions regarding the subject of this research were all open. They asked the participants to indicate a list of factors that they find important for the tablet computer deployment in schools in Brazil. Additionally, they were requested to express their opinion about the tablet computer deployment, some experience they might have had or observed, and some general comments they might have about the deployment process.

The question about the list of factors prompted the participant to be assertive as long as they listed the most crucial factors in the deployment process according to their perceptions. Their responses to this question began to answer the main research question about determining the main factors that influence the deployment process.

The subsequent questions stimulated the participant to present arguments to justify their list of factors and present some possible links between them. Furthermore, the very open answers could bring new factors, not mentioned in the factor list, or the same factors already indicated in the list. In the latter case, the repetition of the same factors in their responses corroborates their importance.

Once the participants started responding to the online survey, those responders who had a profile compatible with the expected stakeholders of the Brazilian deployment had their respective responses analyzed. On the other hand, those responders that did not fit the expected

profile were rejected, forming the excluded population (Ross, 2005), and their responses were discarded.

The initial data collection also counted on some public resources such as papers with a similar approach to this research (Oliveira, 2014; Nascimento, 2014; Araújo & Ribeiro, 2014; Lucas, 2014; Souza, 2014), as well as some interviews with professionals involved in the tablet computer deployment. These interviews, such as the one made with the Ministry for Education, Dr. Aloísio Mercadante (Mercadante, 2012) and with experts on technology in education (Educarede, 2011), were very valuable because the questioning made during the interviews would have been the same for this research. The inclusion of these resources was based on the fact that all of them present arguments that perfectly fit to the approach that is used during the implementation of the Grounded Theory steps. Their content can be considered responses to some of the questions placed on the online survey and raised from the collected data.

Figure 2 represents the initial data collection that took place from the online survey, for which professionals from all over Brazil were invited to participate through the BADE email list and public resources of information with a compatible approach with this research.

The service Survey Monkey was used to implement the online survey, and the participants did not take more than fifteen minutes to get through the whole online form. The goal of this first data collection phase was not to exhaust all the possible answers from the responders. Rather, it enabled an initial analysis of the responses and, then, new questions emerged progressively, focused and oriented towards the found categories, exactly as described by Fernandes & Maia (2001, p. 55).

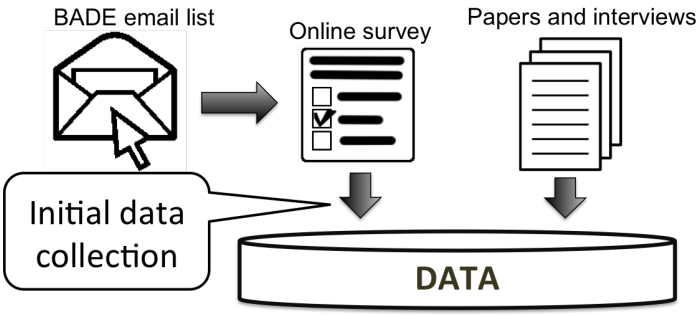


Figure 2. Initial data collection process. The data collected comes from two sources: the online survey, compatible articles and interviews.

Moreover, the online survey enabled the researcher to reach stakeholders in different parts of Brazil, each with their respective roles in the deployment process. Then, for the next phases of data collection, the researcher would be able to contact the participants directly, either by email, by phone, or even in person. These latter contacts were very enriching for the final results of this study. It helped to understand better some statements made by the participants through the online survey.

The next section describes how the analysis was done on the data collected initially and the following steps after that.

The defined population may be expanded, depending on the analysis of the responses given by the participants through the online survey. If some stakeholders are frequently cited in the answers and there was no participation from them in the online survey, other communication channels will be used to reach those potential participants that are considered important for the deployment process but did not participate in the online survey. As long as the analysis of the responses obtained from the defined population leads the researcher to new concepts and categories, new sampling specifications might be raised. Thus, the data collection process

continued with new samples and new data gathering, until no more significant concepts were raised, i.e. until the saturation point of the data collection.

Analysis

The analysis process was supported by the use of Atlas.ti, whose provider states that the software is "a powerful workbench for the qualitative analysis of large bodies of textual, graphical, audio and video data" (Atlas.ti, n.d.). The software allows the researcher to focus on the material itself, counting on tools "to help to arrange, reassemble, and manage your material in creative, yet systematic ways" (Atlas.ti, n.d.). However, it is important to note that the software (version for Macintosh) presented some limitations in regards to productively treating the data within the paradigm of Grounded Theory, which requires some peculiarities inherent to this theoretical framework while the software better meets the requirements of generic qualitative research. For instance, the memos had to be related to one, and just one, category. The user could not relate a memo to more than one category, which is a procedure that is common in the implementation of Grounded Theory. Because of this, the researcher had to use other software to support the demands of Grounded Theory analysis.

This analysis includes three types of coding: open, axial, and selective coding. The first two take place as soon as the data starts being collected, as shown in Figure 3. Notice that the open and the axial coding take place at the same time during the initial analysis. Below, the text depicts each of the elements of Figure 3 to explain how Grounded Theory was put into practice and how it happened in this research implementation.

Open coding. The open coding consists of analyzing the collected data and identifying concepts and events that can be tagged with a code. To understand the circumstances that

surround the concepts and events and to enrich the analysis, the researcher uses codes to label the themes and concepts found in the data analysis (Corbin & Strauss, 2008, p. 89).

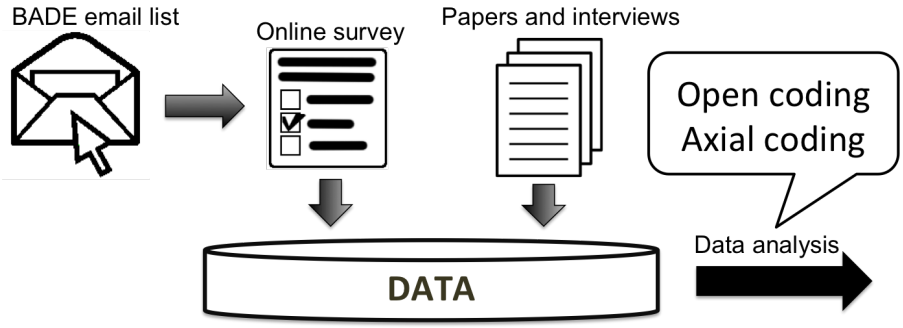


Figure 3. Open and axial coding. The initial data analysis based on the open and axial coding.

The association of each theme or concept to a code not only is provisory it is not exclusive (Fernandes & Maia, 2001), i.e., the same concept or event could be associated with more than one code. In this research, there were 281 themes, concepts, or named quotations by Atlas.ti, associated with 52 codes during the open coding.

For instance, the participant #70 stated: "The major impediment to the growth of tablet usage lies in the availability of quality didactic material." The participant described a theme that received the code "content." The participant #72 stated: "There are very useful online resources that need to be included in the lesson plan. However, when I tried to use some online and open educational resources I could not because there was no Wi-Fi connection in the classroom." This quotation describes two themes; one received the code "online resources" and the other received the code "inexistent internet connection."

Axial coding. According to Fernandes & Maia (2001), after the open coding is done, the researcher can perform the axial coding, which consists of reorganizing the data with the identification of relationships between codes via a combination of inductive and deductive thinking. In order to do this, the researcher needs to use theme or concept categories, which

mean the code names and their respective properties. It results in the combination of categories related to concepts or themes with shared characteristics.

For instance, the categories whose codes from both participants mentioned in the previous section, which had a conceptual relationship with content for tablet computers, were combined into the category "Content." This meant that the code "content" and the code "online resources" were related to the category "Content," as shown in Table 1.

Table 1

Examples of codes related to the same category.

Category name:	Content	
Category property:	Any code related to any educational resource that may be used by the teachers as being a content or related concept, such as online resource, social media, app, and operation manual.	
Related codes:	Code	Property
	content	Any quotation associated with any kind of content to be used and/or developed by the teachers in their classes with the tablet computer.
	online resources	Any quotation concerning online resources available for the teacher to use in the tablet computer context, such as Learning Management Systems, Open Educational Resources, and social media.

Notice that to differentiate code names from category names, this study named codes with words entirely in lowercase letters whereas the categories were named with the first letter capitalized. It was useful since part of the name of the codes related to important factors which ended up being used to name categories, as a result of the process of developing the code and category terminology.

The public resources of information also made part of the analysis. For instance, what was told by the Brazilian minister of education Aloisio Mercadante (Mercadante, 2012) was included in the initial analysis. His arguments on the Brazilian tablet computer deployment was perfect for this dissertation purpose, and this research would not have a better approach to explore the theme in an hypothetical and unlikely interview to the researcher than what was presented by him and made publically available.

Memoing. During the data analysis, especially for coding phases, it is important that the researcher performs the memoing task, which consists of maintaining written records of the theory development, which means the findings and the description of the studied reality. This process, highlighted by Corbin & Strauss (2008, pp. 117-120), was crucial for identifying and organizing the concepts and themes of the events and occurrences related to the studied phenomenon. “They represent an analyst’s impressionistic understanding of what is being described in the experiences, spoken words, actions, interactions, problems, and issues expressed by the participants” (Corbin & Strauss, 2008).

Memoing means writing the properties for categories and justifying codes chosen for them, documenting their emergent relationships between codes and the progressive integration of categories (Fernandes & Maia, 2001). Memos allow the researcher to follow up changes of direction in the analytic process of the data, as well as to make it easier to perceive the adequacy of the research question. In sum, memos provide a picture of the research process as well as about the substantive findings of the study, all based on the interpretation made on the collected data and the relationships among the concepts rose from the data.

In this study, the memoing demonstrated to be one of the most important elements for implementing the research. It made viable the narrative that the researcher needed to establish

the links between codes and categories, to explain the concepts and phenomena identified in the entire study, and to write this dissertation. In the final study step, each category had its memo with the description of everything related to the respective category and its codes.

In fact, the memoing process helps not only with the combination of categories described in the previous section but also with the questioning of the data under analysis. It can lead the research questions to a more focused and deeper inquiry as well as the occasional new sampling of the defined public. This process is explained in the next step of the Strauss approach for Grounded Theory.

Theoretical Sampling

After the open and axial coding is done, based on the note taking that took place during the data collection process and the memos done for structuring and formalizing the analysis, the researcher may perform the theoretical sampling. According to Corbin & Strauss (2008, p. 143), "the purpose of theoretical sampling is to collect data from places, people, and events that will maximize the opportunities to develop concepts regarding their properties and dimensions, uncover variables, and identify relationships between concepts."

The initial analysis brings unpredictable findings, which generates new questions about the research subject. Therefore, the data analysis needs new sources of data to find the answers to those questions. The researcher needs to ask the new questions to the research participants to gather new data. These participants are chosen according to the questions raised by the initial analysis (Corbin & Strauss, 2008, p. 145). Theoretical sampling means choosing the new participant sample to respond to the new questions. The theoretical sampling allows the researcher to direct the study, to look for new approaches, to fill possible gaps in the analysis, to confirm some findings and consolidate the respective categories, or still create new categories

based on new findings. Figure 4 reflects what Corbin & Strauss (2008) recommend to perform the theoretical sampling procedure.

In fact, after the first data analysis, new questions came up from the data. In order to gather the answers needed, new samples of participants were contacted by email, phone, and/or met in person to confirm new impressions about a specific concept.

For instance, some of the participants stated that auditing the pedagogical outcomes from the use of the tablet computers would be important to prevent the misuse of the devices. Consequently, the researcher requested more details for those that responded with something related to "audit." This checking procedure assures that their narrative was correctly interpreted. Moreover, other participants were questioned about this factor to confirm that it makes sense in other scenarios.

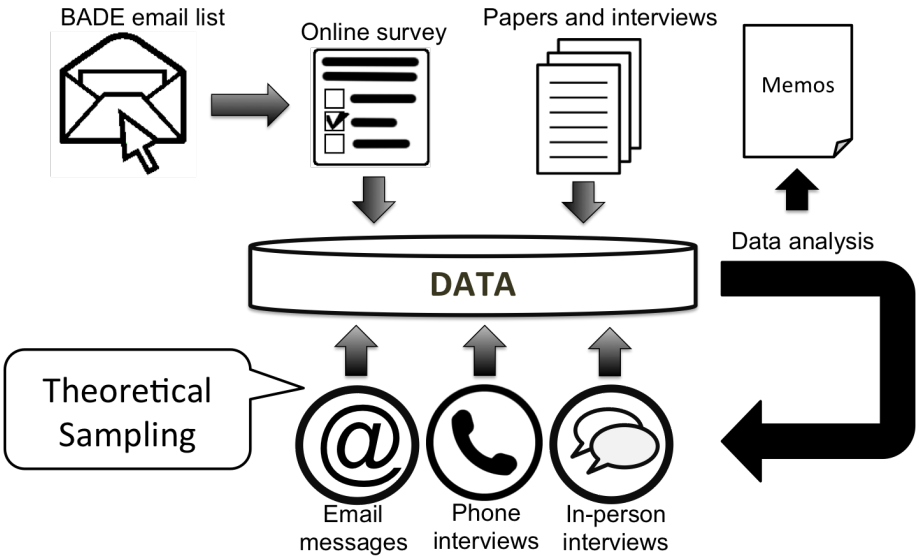


Figure 4. Theoretical sampling. Procedure performed by researcher after the initial data collection.

Sometimes the theoretical sampling can occur in a very dynamic way. The researcher does not need to formalize the procedure to do the theoretical sampling. Some of the concepts

gathered from the initial data were confirmed just by observing those concepts when visiting schools. For instance, the lack of power outlets in the classrooms, which was a reason for criticism on some online survey responses, was confirmed in all visited schools, either by observation or by in-person interview responses.

As advocated by Corbin & Strauss (2008, p. 149), even after finishing the data collection, the researcher still had conditions to perform theoretical sampling. Thus, some of the newly found concepts were reviewed with a "fresh eye," leading the researcher to relate incidents and events that point to a specific concept. This post data collection of theoretical sampling was important for reviewing some of the concepts found in the data, which resulted in changing and/or recategorizing some of the codes.

After the theoretical sampling is done for the first time, which happens after the first data collection takes place; it generates more new data to be analyzed. In its turn, the new data might result in new theoretical sampling, which will generate more new data again, and so forth. After performing this cycle several times, it ends after the theoretical sample does not result in new information anymore. It means "the data gathering and analysis add littler new to the conceptualization, though variations can always be discovered" (Corbin & Strauss, 2008, p. 263). Consequently, the theoretical saturation has taken place. Figure 5 illustrates the two concepts: the theoretical sampling cycle and theoretical saturation in the scheme of this study.

In this study, the factors to consider important in a tablet computer deployment in schools in Brazil were represented by the most important concepts which rose from the collected data. For these main concepts, the theoretical saturation was reached quickly. This happened because there was no divergence between the participants regarding the main factors to consider in the

studied deployment. Only the secondary factors, which were not so frequently mentioned by the participants, demanded some theoretical sampling.

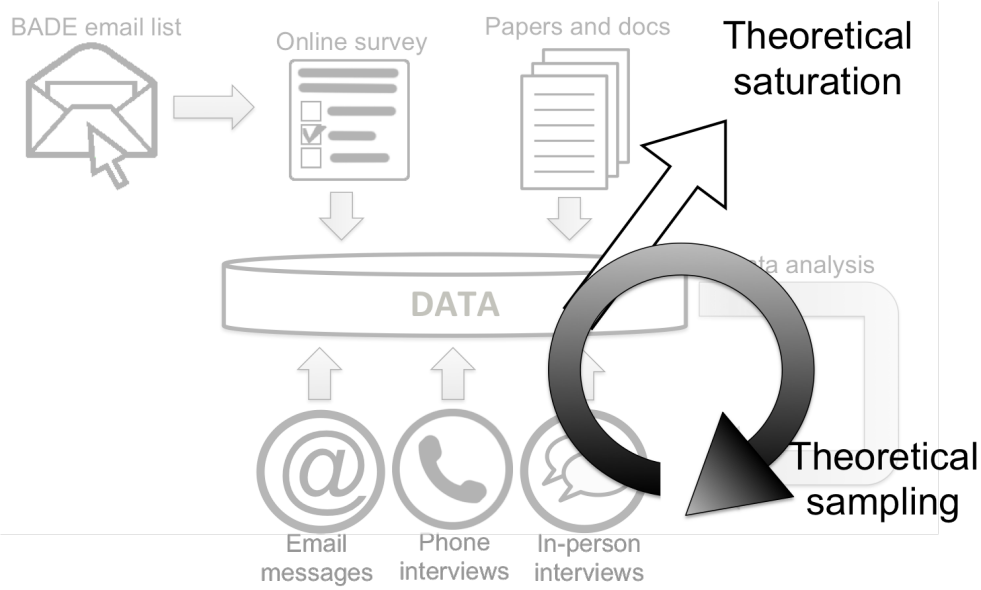


Figure 5. Theoretical sampling circle and theoretical saturation.

It is important to notice that the research respondents have received the tablet computers or had some contact with those that received them, in a way that allow them to have an opinion to share about the deployment process which they had contact with. As long as the research findings are based on their statements on the tablet computer deployment, the research findings are valid for the purpose of this study. As long as there are responders from all over Brazil, the responses are fairly homogeneous across the country, and the theoretical saturation was reached, the research findings can be considered valid to describe the main factors that influence the deployment of tablet computers in public schools in Brazil.

More details about the concepts that emerged from the data will be discussed in the next chapter. For now, it is important to describe the following last step of the Corbin & Straus approach applied in this study: the theoretical construction.

Theoretical Construction

As stated in the last section, the iterative process involving the steps of analysis and theoretical sampling will be performed until the point of theoretical saturation, i.e., when the newly collected data does not lead to any new significant category anymore (Corbin & Strauss, 2008, p. 112). Consequently, it is time to stop making memos and to start generating the results. At this point, the memos can help to construct a skeleton of the factors that influence the studied tablet computer deployment and much of the narrative needed for writing the obtained results. Furthermore, they can be used to construct a model that represents the relationships between the factors (categories) that arose from the data. In order to do that, the researcher needs to perform a new coding process: selective coding, explained below.

Selective coding. Theoretical saturation is followed by selective coding, which consists of establishing the most important category of the analysis. “Although the selective analysis is not much different from the axial coding, this process has a more abstract coding process (Fernandes & Maia, 2001, p. 60). Strauss & Corbin (1998) define selective coding as being "an integrative process of selecting the core category, systematically relating it to other categories, validating those relationships by searching for confirming and disconfirming examples, and filling in categories that needed further refinement and development" (Strauss and Corbin, 1998). The result of this type of coding can be expressed graphically. Thus, selective coding allows the researcher to relate systematically the main category to the others, resulting in a storyline that describes the studied phenomenon. Figure 6 exemplifies the process of selective coding. Notice

that there is a main category, chosen by the researcher as being the most important for the theoretical construct. The relationships between the categories are represented by arrows and driven by the information contained in the memos produced during the research analysis.

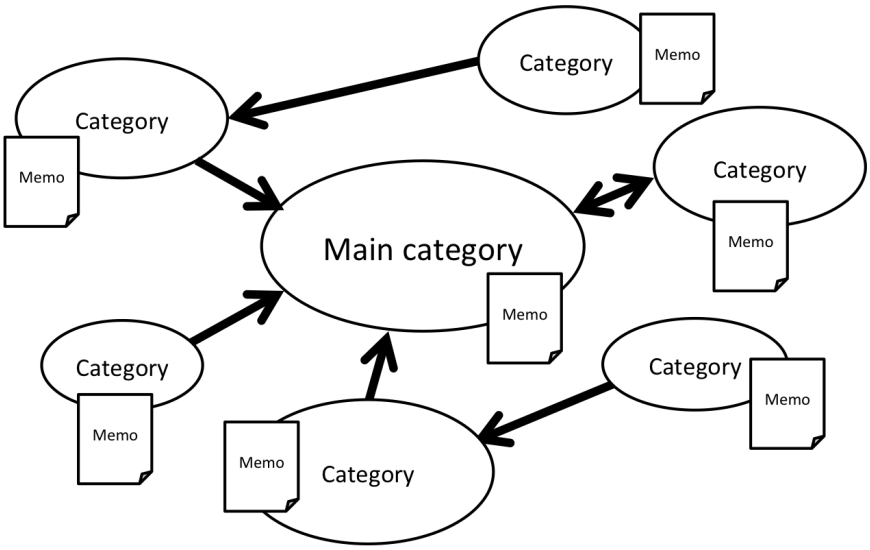


Figure 6. Generic example of a diagram depicting selective coding. .

This storyline resulting from selective coding can express a theoretical construct that one can understand, generalize and apply in the real world. This theoretical construct might be a framework, a model or even a theory.

Significance of the Research Study

The use of tablet computers in schools is a relatively recent phenomenon, especially when considering the new technologies. The large-scale use of tablet computers in schools has only become the reality in 2012, with initiatives in some school districts in California (Frank, 2013) and Thailand (Sakawee, 2013). Although there are some signs of problems in these and other deployments, the use of tablet computers in schools is just in the beginning of its era. As long as there are hardly any studies on the implementation process of the new teaching paradigm (McGee & VanderNoor, 2013, pp. 12-13), this research has significance for all scholars,

teachers, principals and education policymakers that have some interest in the study subject. The Brazilian educational policymakers will be able to improve their decisions if they have factors that guide them in the implementation phase of the use of tablet computers in public high schools, considering the facilities and difficulties brought on by dealing with large scale numbers of mobile devices.

Research Trustworthiness

Silolia, Biros, Mason, & Weiser (2013) present the steps that can be taken to accomplish trustworthiness of the Grounded Theory approach used in this research. They suggest four factors to accomplish the Grounded Theory trustworthiness: credibility, transferability, dependability, and confirmability. These criteria are described below.

- Credibility – refers to the accuracy with which the collected data corresponds to different realities of the phenomenon. According to Siloia et al. (2013), some of the prerequisites for credibility are the prolonged engagement with the participants, triangulation of data counting on different resources, sharing with the participants the transcripts of the interview, or the emerging concepts of the participants to check. Corbin & Strauss (2008, p. 321) state the same using a different approach. They state that the Grounded Theory research credibility is based on protocols made during the data collection and analysis phase: constant comparison analysis, the use of concepts and their development, theoretical sampling, and theoretical saturation.
- Transferability – this happens through clear descriptions of the research procedures, including the participant's narratives, the interpretation of findings, and contributions from peer investigators (Siloia et al., 2013). In other words, the researcher must provide the research methodology in enough detail to allow the repetition of the study made by

other researchers. An audit trail should be provided and be detailed enough to allow other researchers to repeat the same inquiry in a similar setting (Cooney, 2010).

- Dependability – it refers to the consistency of the findings across time, participants, and analysis techniques (Morrow, 2005). Another individual audits and confirms whether the Grounded Theory procedures are correctly planned and whether they were adequately performed.
- Confirmability – it refers to the confirmation of findings when presented with the same data, testing the 'objectivity' of the research.

All these criteria were met in this study. The credibility was met since the procedures related to Grounded Theory were strictly followed in this study. The transferability was fulfilled since this dissertation documented all the procedures performed during the research and the findings obtained from it, with their respective interpretations. The dependability of this study took place at the doctoral proposal defence, when all the procedures were depicted in detail and an academic committee approved them. Finally, the confirmability was fulfilled with the inter-rater agreement in the coding process. The inter-rater reliability assessment had an inter-rater agreement rate of 75%, overcoming the threshold of 70% indicated by Collin, Karsenti, & Dumouchel (2011, p. 200) for validating the coding. The rest of the outcomes were subjective results, since "the codes are merely an interim product, and they are not the only interim product generated (e.g., the memoing). Moreover, there is a substantial distance that must be traveled during analysis between the time codes are generated and the end result" (Grinter, 2010).

Ethical Considerations

This research study involved minimal risk. The participants recruited for the surveys and interviews were informed of the terms of participation in this research. These terms were clearly written in the Portuguese language in an information letter (see Appendix B), which contains:

1) The purpose of this research study.
2) The guarantee of the anonymity of the participants.
3) That participation was voluntary.
4) The confidentiality of the data collected from the responses.
5) The participants have the freedom to withdraw from the research study with no adverse consequences.
6) The research study conclusions do not contain any names or personal information.
7) The information about the procedures so as to keep all the collected data secure and protected.
8) The information about the US Patriotic Act since the collected data from the online survey will be stored on US territory.
9) The incentive used for the participants in the research.
10) Contact information

All the participants electronically gave the authorization for collecting data through the online survey, after reading the consent letter (see Appendix D). The ethics approval from the Athabasca University Research Centre is presented in Appendix G.

Chapter 4 Conclusion

This chapter outlined the purpose of this study from the perspective of it is chosen theoretical framework approach. It presented the research questions and the research methods,

detailing all the methodical steps that put into practice the Grounded Theory to answer all of the research questions. Then, this chapter presented the significance, limitations, and feasibility of this study. Finally, the ethical considerations related to this study were presented. The next chapter presents the results obtained during the implementation of the research method described in this chapter.

Chapter 5

RESULTS AND DISCUSSIONS

This chapter will present and discuss the results obtained from the data analysis. It depicts the set of factors to be considered in a large-scale deployment of tablet computers in public schools in Brazil. For each factor, this chapter presents the analysis of the qualitative data, which includes some of the responses obtained through the online survey and the interviews done by phone, email and in person. Moreover, it presents the narrative on what was analyzed and observed while visiting the schools across the country, based on the memos produced during the data collection phase.

The content of this chapter is divided into four parts. Firstly, it presents the identification of the participant, which is the data related to the responder profiles, such as age, gender, level of education, and role in the studied deployment process. Secondly, the chapter presents the main factors highlighted by the stakeholders as being important to be considered in a mobile device deployment process. The factors are presented separately, with an explanation of the relationship between each factor and other related factors. Moreover, the text shows a clear definition for each one, with the respective examples of the responses obtained during the data collection, which were translated from Portuguese into English without altering the meaning. After, the chapter presents some important results related to the memos, which highlights the most important factors to be considered and it establishes a hierarchy among them. Finally, there is a discussion on the studied Brazilian deployment based on the findings.

The online survey, which was the first phase of the data collection, had 82 responses. However, 17 of these responses were discarded since they did not meet the requirements established in the invitation letters. The participants should be involved directly or indirectly

with the studied deployment, and most of these discarded participants did not have any contact with the deployment. Rather, they only wanted to express their opinion on this topic. Some of the responses were discarded because of the lack of meaningful content. Thus, the online survey had 65 responses from all over Brazil. Based on these responses the initial analysis could take place, as mentioned in the next section.

Participant Profile Results

The analysis of the participant profile results aimed to check whether there was some potential source of bias due to some characteristics inherent to the participants. Moreover, the analysis of the participant profile allowed the researcher to identify possible relations between some specific profile element and the correspondent responses.

The participant profile results showed that no profile element was a source of any bias. If some profile element with a potential of inserting bias in the results were found, the online survey responses could be compromised. For instance, if the vast majority of the responders were from a specific state in Brazil, or had some specific age, all of these examples singly could have biased the initial open/axial coding and compromised the entire research.

It is important to mention that this profile corresponds to those 65 eligible participants that responded to the online survey, which corresponds to the first phase of the data collection. After the initial open and axial coding, fifteen new participants were added to the research data, during the phase of interviews and visits. The theoretical sampling was the motivator for visiting five schools distributed across the Brazilian territory, whose positions are identified in the map presented in Figure 7. The visited schools were chosen based on geographical position and easiness to have permission to access their facilities since the initial analysis demonstrated that there was no response bias based on geographic position. Even though, the researcher included

schools in different regions of Brazil to know in person this reality. The visited schools are located in the most populated part of Brazil, the east coast (IBGE, 2010).

The interviewed teachers were in the break during the researcher visits to schools where the tablet computers have been deployed. The invitation was open and made in person to all teachers that were present in the school-teacher meeting room, during the coffee break. The teachers were interviewed separately, and in a private room their statements were typed into memos and immediately submitted for their approval.

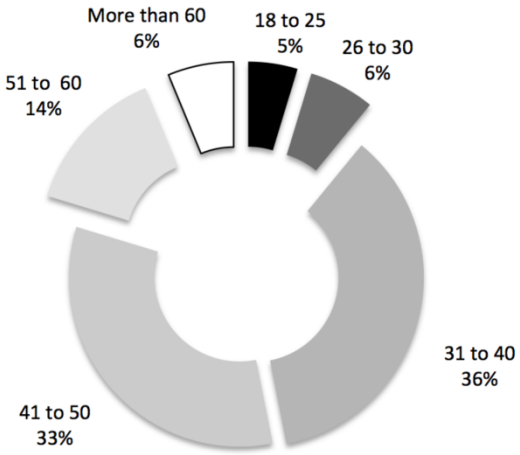


Figure 7. The distribution of the research participants according to their age groups, in years.

Most of the new participants did not provide their complete profile information. However, it was not considered a problem as long as the number of additional participants was small and the participant profile analysis just aimed to identify particular sources of bias. Furthermore, the most important variables regarding to possible bias were known: gender, deficiencies in the deployment process, and the work place. The participant profile information is presented below, with the respective analysis for each data set collected.

Age groups. Figure 7 shows the distribution of the research participants according to their age groups. The predominance of professionals in their thirties and forties is considered

normal. It corresponds to the period after which professionals get their graduate degrees, which is usually accomplished on average by the age of twenty three in Brazil (Ministério da Educação, 2011b), and retirement, which is usually at the age of fifty five on average. Therefore, there is no potential bias in this research due to the predominance of participant age.

Gender. Since 58.8% of the university graduates are women in Brazil, according to the census performed by the Ministry for Education (Ministério da Educação, 2011b), the results obtained on gender corresponded precisely with the average distribution of the part of the population whose profession is related to educational activities. Figure 8 demonstrates that 58% of the participants were women, and 42% were men. As a result, we can conclude that there was no potential bias in the research results generated by the gender of the respondents.

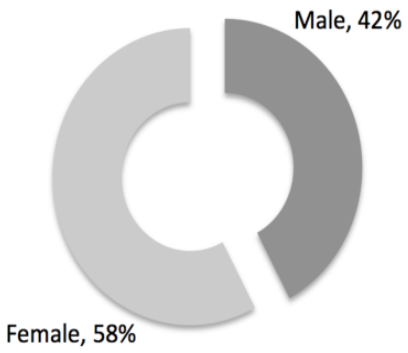


Figure 8. The distribution of the research participants according to their gender.

Home state. The participants were from seventeen out of the twenty-seven Brazilian states. As can be seen in Figure 9, there was a predominance of participants from some specific states. However, the first eight states listed below correspond to the most populated states in Brazil according to the Brazilian official statistics department. (IBGEb, n.d.) Hence, it is normal to have such states as being the homeland of most of the research participants, which means that there is no potential bias due to the predominance of responses from a non-populated state.

Figure 10 shows the map of Brazil, with the number of respondents and their respective cities, with the approximate geographical position. Also, it indicates the position of the five cities which had school visits. The Table 2 shows the list of participant's cities, states, and respective responders for each one. The Table 3 shows the list of cities visited, with respective states and number of research participants.

It was observed that there were participants from all over Brazil, including cities very far from the most populated areas, indicated by the concentration of numbers on the map. This distribution indicated that participants from all regions of Brazil took part in this research and narrated their personal experiences with the large-scale deployment of tablet computers in public schools in Brazil.

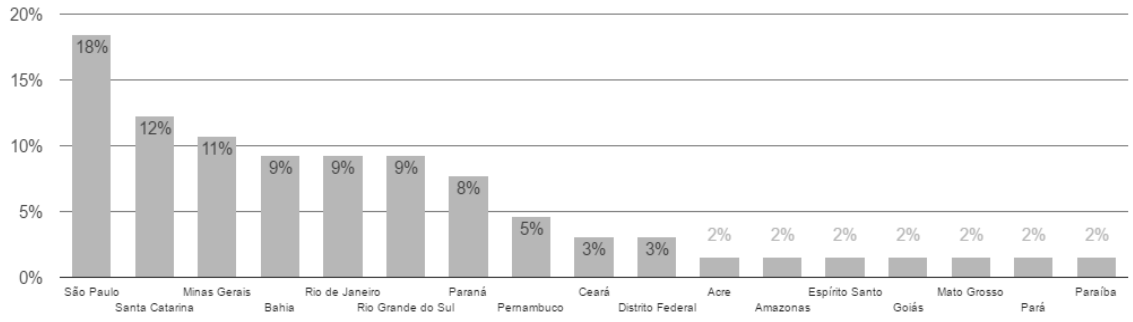


Figure 9. The distribution of the research participants according to their home state.

Figure 10. Map of Brazil and its states. The position of the cities from which there were participants, with the respective number of responses and approximate geographical position.

Table 2

Number of valid online survey respondents for each city and state

City	Number of respondents/city	State	Number of respondents/state
Rio Branco	1	Acre	1
Manaus	1	Amazonas	1
Salvador	3	Bahia	6
Piritiba	1		
Alagoinhas	2		
Fortaleza	1	Ceará	2
Lavras	1		
Brasília	2	Distrito Federal	2
Linhares	1	Espírito Santo	2
Vila Velha	1		
Goiânia	1	Goiás	1
Cuiabá	1	Mato Grosso	1
Itaúna	1	Minas Gerais	6
Montes Claros	1		
Belo Horizonte	3		
Esmeraldas	1		
Belém	1	Pará	1
João Pessoa	1	Paraíba	2
Campina Grande	1		
Londrina	1	Paraná	5
Maripá	1		
Curitiba	1		
Foz do Iguaçu	1		
Quedas do Iguaçu	1		
Olinda	1	Pernambuco	3
Garanhuns	1		
Petrolina	1		
Rio de Janeiro	5	Rio de Janeiro	6
Nova Iguaçu	1		
Canoas	2	Rio Grande do Sul	6
Porto Alegre	2		
São Leopoldo	1		
Cachoeirinha	1		
Criciúma	2	Santa Catarina	8
São José	1		
Florianópolis	2		
Concórdia	1		
Joinville	2		
Indaiatuba	1	São Paulo	12
Guarujá	2		
São Paulo	4		
Engenheiro Coelho	1		
Santos	1		
Piraju	1		
Taboão da Serra	1		
Campinas	1		

Table 3

Number of teachers interviewed at their respective schools for each city and state.

City	Number of interviewees/city	State	Number of interviewees/state
Vila Velha	2	Espírito Santo	2
Campina Grande	4	Paraíba	4
Rio de Janeiro	1	Rio de Janeiro	1
Araranguá	4	Santa Catarina	8
Criciúma	4		

Highest education level. As shown in Figure 11, there is no uncommon predominance of a particular profile in regards to the highest education level of the participants. In fact, according to the analysis done, most of the participants that had only graduate or certification degrees were the professionals directly related to the school routine such as teachers, support teams, and pedagogues. Whereas the participants that had a master or doctoral degree were mostly those that were outside of the school routine, such as researchers, consultants, and policymakers. Once more, there was no reason to think that this distribution of education level would lead to a biased result in the research.

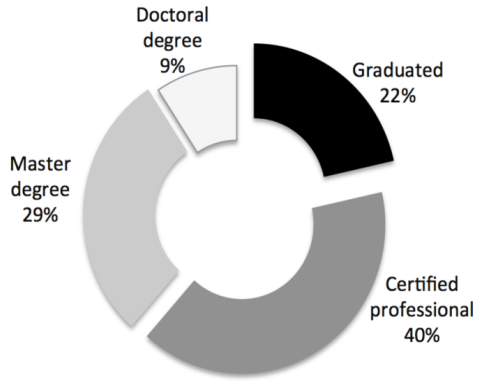


Figure 11. The distribution of the research participants according to their education level.

Professional experience. The relatively balanced distribution shown in Figure 12 demonstrates that there were professionals with all sorts of time experience among the research participants. Hence, there was no bias generated by the number of years of work experience of the participants. It would have been an issue had the results demonstrated that, for instance, the vast majority of the participants had only up to five years of work experience.

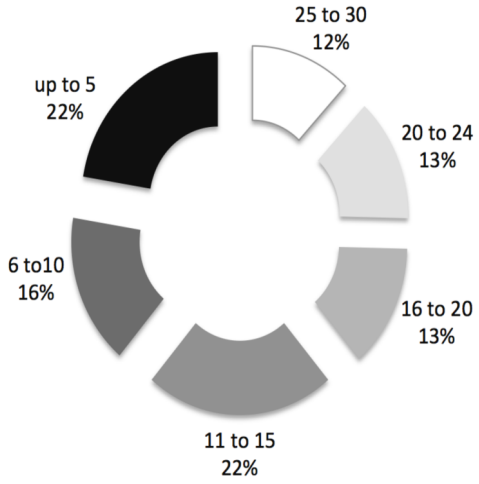


Figure 12. The research participants according to their work experience, in number of years working in their field.

Roles in the deployment. The question about the role that each participant had or has in the studied deployment was an open question. Hence, the responses varied according to the

terminology of each state or even to the personal description that each one had about their respective roles. At first, it resulted in a very wide range of roles, making it a challenge to analyze. Thus, the researcher had to classify the roles accordingly to the type of task supposedly associated with each declaration. For instance, technical support and technical assistance were considered the same role. Similar combination took place for the roles of training facilitator, pedagogue, and trainer. As a result, the researcher could summarize the roles as presented in Figure 13. Notice that many of the participants had declared more than one role. For instance, one of the participants had experienced four different roles during the deployment: teacher, researcher, trainer, and pedagogue. It did not necessarily happen at the same time, but he had the opportunity to experience the deployment with different points of view.

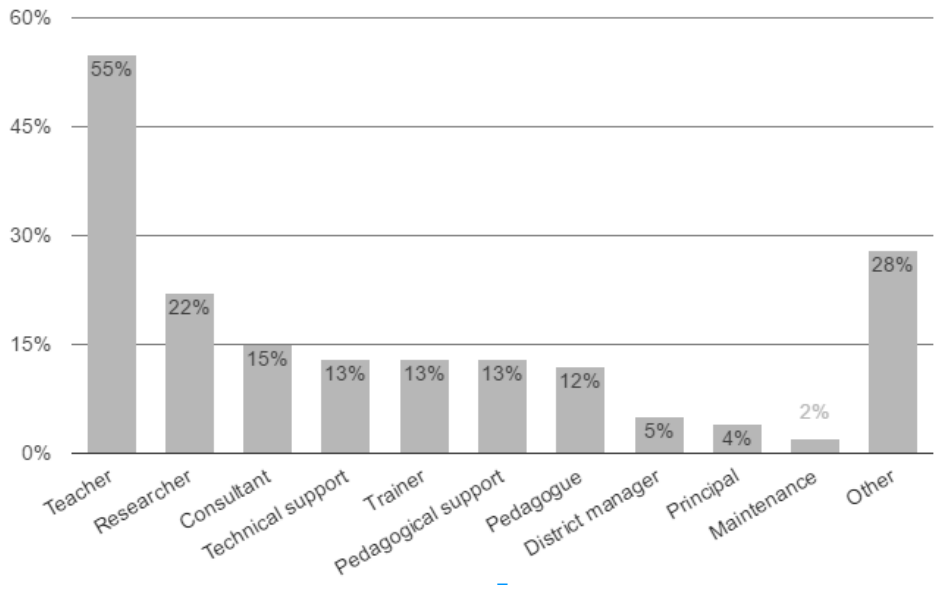


Figure 13. The participant profile according to their role in the deployment.

Although "teacher" has been, by far, the most declared role, it is not a problem. The teachers were numerically the most involved professionals in the deployment process. Therefore,

they are supposed to make up the majority of participants in this research. Then, it does not constitute a source of bias.

There is no other role with a higher percentage of participation in this research. Instead, the number of participants that had the opportunity to get involved with the deployment such as district managers or principals was small compared to other roles. It is entirely acceptable since there are fewer professionals in high-level positions than in lower level posts, such as technical support or pedagogues. Hence, the role of the participants in the Brazilian deployment didn't insert any bias in the research results.

Subject matter. The participants that were teachers were requested to state the subject matter they taught. Figure 14 shows the distribution of subjects the participants taught. Notice that many of the responders declared that they taught more than one subject matter.

As long as there was no obvious predominance of any one subject matter, this part of the participant profile couldn't be considered a source of bias.

Having no bias generated from the participant profile, the researcher could continue to the next data analysis phase, which focused on the main research question of this study: What are the factors to be identified in a large-scale deployment of tablet computers in a public high-school district? The response is presented in the next section.

Main Factors Considered Important for the Deployment Process

The Grounded Theory approach was used to interpret the data collected in the last section of the online survey questionnaire (see Appendix C). The open ended questions focused on the impressions of the participants over the tablet computer deployment in schools. The survey requested respondents to mention objectively the factors that they thought were important to be considered in a tablet computer deployment. The nature of the questions allowed the respondents

to divulge any positive or negative experiences they had or have in the deployment process, as well as any other comments they had or have about the subject of this study.

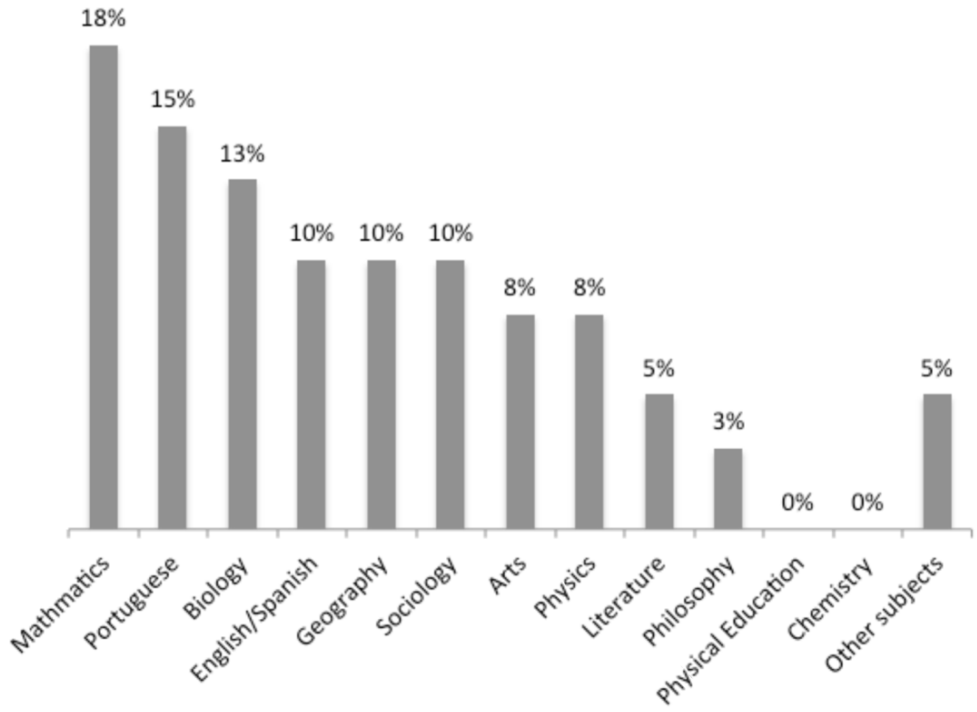


Figure 14. The subject matters taught by the participants.

First, the researcher performed a Grounded-Theory open coding over all data collected, which generated more than 50 different codes. At the same time, the researcher wrote memos related to the codes. Based on the constant comparison between the quotations that generated the codes and the written memos, the axial coding produced thirty-three different categories. After the second round of axial coding, the data analysis resulted in sixteen categories. The category combination was led by the analysis of the relationships between the categories with each other, aiming to reach a model that could describe the phenomenon that drives the studied deployment.

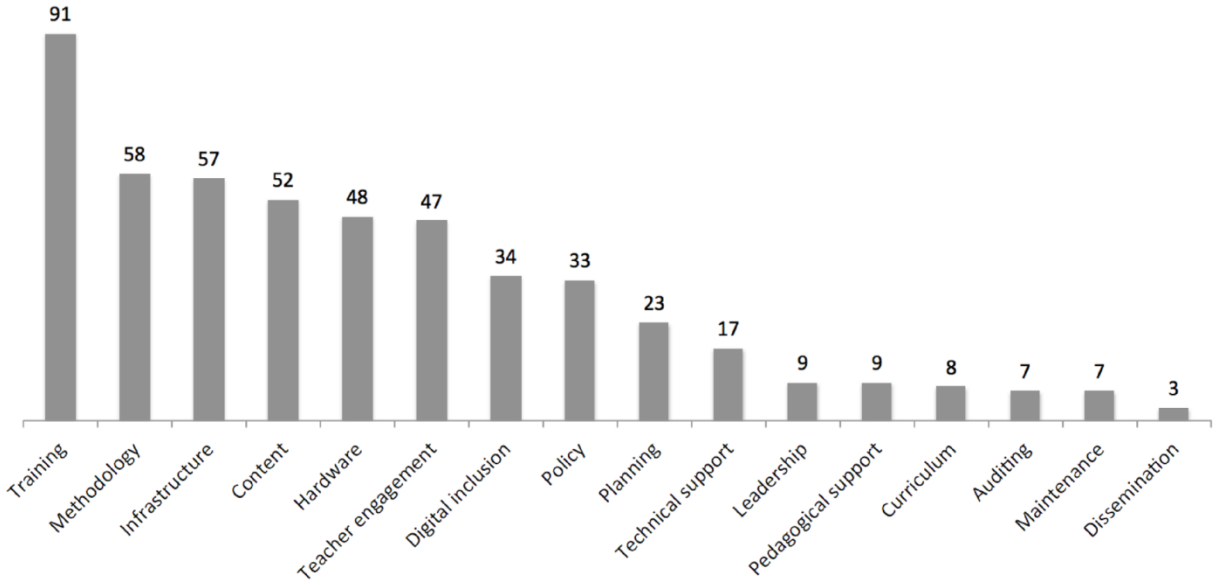


Figure 15. The resulting categories from the Grounded Theory analysis.

Figure 15 shows the sixteen categories that arose from the grounded data, which correspond to the sixteen factors to be considered in the deployment. They are organized according to the frequency of coding for each category although, in an interpretativist research like this one, the frequency of coding is important but not determinant to define the importance of each code. Appendix E presents the codes originally generated during the first open coding process and the description that guided the use of the respective categories during the rest of the coding process. The 16 categories were obtained from 381 quotations, which generated 503 codes distributed as shown in Figure 15.

Above, all the categories shown in Figure 15 are depicted in detail, along with some observations written in the memos produced during this research. These observations give the big picture of the Brazilian tablet computer deployment and describe the relationships among categories for each item. Since each category corresponds to a factor that influenced the tablet computer deployment, from now on they will be called ‘factor’ in the text that describes them

below. Furthermore, the sequence of factors is presented according to a convenient logic for each item.

Hardware. The most basic factor to be considered in the tablet computer deployment is the device itself, which is labeled as hardware. This factor is related to any citation on the tablet computer as a product, such as performance, battery life, durability, resistance, cost, and facility of use.

The tablet computer to be deployed is bought through a Federal procurement process, which is based on bidding that pays millions of dollars to the provider that offers the best price for the device. Although there is a specification for the product, it is possible that there are some breaches that lead the product to receive negative criticisms, as in the case of the deployment in Brazil. Some examples of hardware criticisms are presented in Table 4.

The complaints about the battery recharge issue were recurrent in different Brazilian states, and it is likely related to a specific lot of the seven-inch devices, since it happened only with 7” tablet computers deployed by mid 2014. It was said that the problem was related to the recharge connector, which did not work properly. The ten-inch devices did not receive any complaints regarding the hardware.

The size of the tablet computer memory was another issue that had a high impact on teacher engagement. As there are a lot of classrooms with weak or no Internet connectivity, a way around the problem could have been to store the content on the tablet computer for offline presentations to the class. However, the basic memory did not allow for this kind of solution. In fact, the hardware specification was so weak that it made some teachers feel uneasy about the damage to their image as professionals.

Table 4

Examples of statements uttered by the participants on the Hardware factor

"The tablet computers were a laughing-stock from the student's point of view due to their limitations especially in regards to insufficient memory, slow processors, and short battery life."
"I did not even get to recharge the tablet computer battery the first time I tried it. I had to return the device to fix the problem. I had to wait for several weeks before it was returned, only to have the same problem come up again. Hence I gave up using it and returned the device for good."
"There are tablet computers with 4GB, 8GB and 16GB of memory. That is very limited, especially when they come with pre-installed apps related to the provider's commercial interests."
"During the first four days of usage, the device did not have the performance compatible with a teacher's needs. It had very little capacity; it did not support the use of Dropbox, which is a tool used by the school. It was very slow in responding the commands, the zoom command did not work with the use of fingers – a basic feature for any tablet computer – and it did not allow me to access my emails on the Gmail website, and would freeze all time."
"The tablet computer was of poor quality, which restricted its performance in classroom activities. I tried to use it at the beginning, but it was impossible to keep using it. The tablet computer that I use nowadays is my private device, an iPad2, which is a great quality, high-performance device that allows me to develop the activities I am supposed to present in my classes."
"When used just after it was delivered, it seemed to work smoothly, without any delay, but I did not have the opportunity to use a tablet computer after it was full of content and some apps were installed, which supposedly reduces its performance."

Some of the visited schools had mostly the seven-inch devices; others had more of the ten-inch device. Undoubtedly, the larger devices had a more robust technical specification, and it gave the teachers a better level of satisfaction when using the devices.

Maintenance. This factor is related not only with the procedure of fixing broken hardware, but also with all the procedures and outcomes around it. It involves citations such as the logistics around sending broken devices, the time that it takes to receive the fixed device from maintenance, the frequency with which the devices break down, the quality of the repair,

and any other way of replacing a broken device. Table 5 exemplifies some typical comments on the tablet computer maintenance.

Table 5

Examples of statements uttered by the participants on the Maintenance factor

"If a tablet computer breaks, the maintenance takes weeks or months to return the repaired device."
"I did not even get to recharge the tablet computer battery the first time I tried it. I had to return the device to fix the problem. I had to wait for several weeks before it was returned, only to have the same problem come up again. Hence I gave up using it and returned the device for good."

Although the Maintenance factor was coded seven times (out of 503 codes), it was mentioned especially by the supporting staff of the schools, which caused it to be interpreted as being one of the most important factors to be included in this dissertation list. Of course if a factor is mentioned many times by the respondents, likely it will be considered an important factor, but the opposite is not true. It is not because this factor was mentioned just few times, if compared with the other factors, that maintenance should not be considered a factor to compose the list of this dissertation. The decision to whether or not consider an important factor is also based on the rational approached on the factor, interpreted by the researcher. For this reason, maintenance was considered an important factor for the deployment, and it takes part of the model presented in this dissertation.

Except for the complaints about the lots of devices that had a problem with the battery charger connector, mentioned in the last section, no other significant issue was reported by the participants. The complaints about the charger connector ended up highlighting the fact that the maintenance support was satisfactory since the defective devices were fixed in an acceptable

time frame, but the time spent to make the device to reach the maintenance support and return to the school after the fix is impractical for the educational context. The way that the policymakers planned the maintenance seemed as if they were counting on very high-quality hardware, with an insignificant percentage of hardware failure. The maintenance not only implies fixing the device, but it also involves replacing it as soon as possible, since the lack of the device can compromise all the work of the teacher that was supposed to use the device. In a deployment of such a scale, it is important to have backup devices for timely replacement of the occasionally broken hardware (Bassi, 2010, p. 24).

In the case of the Brazilian deployment, it was not that simple. Firstly, the devices were distributed without predicting the eventual need for replacement devices. All the devices were supposed to be handed to the teachers. Secondly, each device was linked electronically to an individual by the use of the teacher's official identification, which was registered in a centralized online control at the Ministry for Education. When a teacher's device broke and was sent for maintenance, there were no "extra" devices, besides it was not that easy to release another device to a teacher that already had a device registered in his/her name.

Another problem with the maintenance policy reported by participants regarded the maintenance continuity. In at least one state, the maintenance contract was not renewed after the first year of the deployment. Unlike static equipment, such as interactive smart boards and desktop computers, the tablet computers are much more likely to need maintenance. Being mobile devices, they are much more likely to suffer all manner of damages, such as falls, connector breaks, and liquid spills. Moreover, the number of devices is higher than any other kind of technological equipment in a school. Again, having maintenance coverage is essential to keep the project running smoothly over the years. However, during the whole preparation and

research period for this study, no information about the plans to maintain the devices until the end of the hardware's lifespan was found.

Infrastructure. This factor was heavily mentioned during this research, and it involves any element needed to provide the physical support for the use of tablet computers for educational purposes. Having only the mobile device is not enough to put it into the educational context of a classroom. The teacher needs peripheral equipment to support the use of tablet computers in the classroom, such as big screen televisions, projectors and/or interactive smart boards. If the teacher or the pedagogical support produces content to present in the classroom, they need computers with appropriate software installed. In order to make a richer use of the tablet computer in the classroom, it is mandatory to have good quality Internet connection covering the whole school. Even very basic infrastructure elements such as appropriate power outlets are important to improve the quality of the teacher's work in the classroom.

To understand better the context in which the infrastructure is mentioned in this section, it is important to know what the main types of classrooms are in public schools in Brazil and how they work. Table 6 describes these types of classrooms with the respective operating logic.

Table 6

Types of classrooms found in public schools in Brazil

Standard Classroom	This is the traditional classroom, with desks for the students and the teacher, and a blackboard. The classroom belongs to a set of students, with different teachers coming for each of the subjects they teach. To use the tablet computer for this type of classroom, the teacher needs to bring the mobile device accompanied by a television, projector or interactive whiteboard to the classroom. It takes some time to set up all the devices before starting the lesson presentation. After the class ends, the teacher or the technical support needs to return all the paraphernalia to the computer lab, warehouse, or to another classroom, where it will be used again to present lessons. This type of classroom represents the vast majority of classrooms in public schools in Brazil.
Multimedia Classroom	This type of classroom also belongs to a set of students, with teachers changing for each class schedule. However, the classroom has a fixed set of multimedia peripherals, such as a television or projector, and sound system. Hence, the teacher just needs to bring his/her tablet computer and connect it to the multimedia device. This type of classroom is not common in ordinary Brazilian public schools.
Computer Lab	This type of classroom has fixed multimedia devices, like the multimedia classroom, but also has computers on the student's desks. This type of classroom does not belong to any set of students or teacher. Everybody shares it, according to the class schedule and the necessity for each class. The access to the computer lab is managed by the technical support. Every public school in Brazil must have at least one computer lab.
Environmental Classroom	This classroom belongs to the teacher, which contains all the equipment needed to present to his/her classes and changes the set of students for each class schedule. This type of classroom is being deployed in some Brazilian public schools, still with the status of a pilot project.

Table 7 presents some outstanding statements declared by participants on infrastructure in the context of the large-scale tablet computer deployment in their related public schools.

Table 7

Examples of statements uttered by the participants on the Infrastructure factor

"In some schools, the air conditioner brings down the power of the building when turned on at the same time that the computer lab is being used."
"This building is fifty years old. Look at the walls in this classroom. You cannot find any power outlet. How will the teacher use the tablet computer in this classroom? There would have to be a structural reform in the building before bringing the devices."
"The Wi-Fi signal does not reach all the classrooms. I teach two classrooms from the same grade. I cannot present a lesson with the tablet computer in a classroom with Wi-Fi, and present the same lesson without the device in another classroom because it does not have Wi-Fi."
"What really makes the tablet computer worthwhile is the dynamism provided by the Internet: presenting a video from YouTube, 'flying' with the classroom to a place with Google Earth, using interactive online resources. As I do not have a really high speed Internet in the classroom, I cannot use all the strategies I have for my classes. Sometimes I record a video with the demonstration that I was supposed to present in real time in the classroom, and save it on the tablet computer as a backup solution to be used just in case the Internet connection fails. Therefore, I have the limitations of the memory size of the device, which prevents me from storing a library of videos with the device."
"The only place we can use the tablet computer to present lessons is in the computer lab. There we have a projector and Wi-Fi connection. If I could, all my classes would be in the computer lab, but it is not possible because we have only two labs that must be shared with all of the other teachers. "
"The principal does not care if most of the teachers that received the tablet computers did not engage with the project. Why?! Because if there were a lot of teachers adhering to the use of tablet computers in the classroom as announced in Brasília, he would have a big problem to solve. After all, there are not enough televisions or projectors to be used by all teachers if many of them decided to use tablet computers in all of their classes."
"We have Wi-Fi connection in all the classrooms, but only teachers access this Wi-Fi. I have a blog in which I publish all my lessons, with texts, links, and embedded videos from YouTube, some of them were produced by me. Therefore, I just need to access my blog during my classes to present my whole lesson. My students also can access the blog from home, even before the class. The problem is that I do not always have an available projector to use in my classes. There should be more projectors."
"There is a high turnover of the technical support staff as long as they are mostly contractors. They leave the school when they find a better job. It prejudices the whole process of using the technological infrastructure of the school."

Between the elements that compose the infrastructure, the most cited was Internet connection, which corresponded to more than half of the citations associated with the Infrastructure category. Some of the outstanding statements presented in Table 7 demonstrate the importance of having good Internet connectivity throughout the entire school to boost the use of the tablet computer. However, most of the visited schools had insufficient Internet speed to cover the demand generated by the students and the teachers. In a school in Santa Catarina, for instance, they only had an Internet speed of 2Mbps to support around 2,000 students and the administrative sector of the school. This Internet connection speed was established by a Federal Government policy in 2006, but it is entirely obsolete for the current reality regarding Internet usage (Maia & Barreto, 2012).

The second most cited element related to infrastructure regards the peripherals needed to present lessons with the tablet, such as television, projectors, or interactive whiteboards. The Minister of Education, declared in an interview provided in 2012 (Mercadante, 2012), that there would be a distribution of 60,000 "digital portals," which are the mentioned multimedia peripherals. Notice that the ratio is one digital portal for each ten-tablet computer sets, which seems to be insufficient to attend the demand for presentations with the use of tablet computers in some schools. Moreover, in some visited schools, there were no power outlets in the classrooms, which made it impossible to use the mobile devices with digital portals there, except in the school computer lab.

The multimedia classrooms avoid equipment damage because they do not need the back-and-forth moves of projectors, interactive smart boards and televisions. Furthermore, they save class time and human resources required to support the teacher in the equipment installation and uninstallation. Unfortunately, there are very few classrooms like that.

Notwithstanding that the teachers needed to overcome the difficulties created by the lack of proper school infrastructure, at least some of them still needed to pay for the cable that links the tablet to the projector or television. Incredibly, the tablet computer project did not include this simple item, which is mandatory in order to put into practice the basic idea of the project uttered by the Minister of Education (Mercadante, 2012): enhancing the teaching process with modern class presentations.

The visits to the schools left some impressions. The smaller schools seem to have more technological resources in proportion to the number of students attending the school. The schools managed by municipal governments seem to be more efficiently managed than the state schools. The state schools located in the capitals of the states or the main cities appear to have a better infrastructure than the schools located in distant and small cities, inland of the state. These impressions raised a suspicion that the physical distance between the school and the policymakers influences the quality of the school infrastructure. However, there was not enough data to underpin this suspicion, which needs to be investigated better to identify some correlation between the factors aforementioned.

Notwithstanding the cause of problems regarding the infrastructure, it has been an important factor in the deployment and the lack of proper work conditions has prejudiced the teacher engagement with this deployment. It is not by chance that Giacomazzo & Fiuzza (2014) developed research in Santa Catarina involving 44 teachers and found out that almost two-thirds of them did not agree with the deployment of tablet computers. They justify that the schools do not have the appropriate infrastructure, and they do not have the need for pedagogical training.

Curriculum. This factor is related to any action toward the development or adjustment of the curriculum to fit the use of tablet computers for educational purposes. The concept of curriculum

used here is based on UNICEF's definition. It states that curriculum refers to a "set of documents, subject curricula/syllabuses, and relevant supportive learning materials, such as textbooks, teacher guides, and assessment guides" (UNICEF, 2016). In this sense, the curriculum must aim to guide the educators on "how learning experiences within the subjects need to contribute to the attainment of the wider goals of competencies and personal development." (UNICEF, 2016)

In the context of this research, the importance of this factor is highlighted mostly by policymakers and external professionals of the school, such as consultants and researchers. Table 8 presents some of the participant's comments on the necessary curriculum adequacy in the context of the use of tablet computers for education.

Table 8

Examples of statements uttered by the participants on the Curriculum factor

"We have to integrate technology and curriculum."
"We have to have a more meaningful curriculum that facilitates the change in methodology."
"To improve teaching, it is necessary to have structural reforms in the school's organization and the teacher's work. They should observe some aspects such as the creation of public policies focused on the use of technology in education, the predisposition of managers and teachers in favor of using technology in both the physical space as well as in the curriculum."
"From the moment that we used tablet computers to present lessons, it had a high impact on the curriculum timing. Some teaching options before were impossible, now they are feasible, but more time consuming. On the other hand, some subjects can be presented more productively, the time shared between what happens in the classroom and outside of the school changes. The curriculum must follow this change."

All the participant's responses on this factor focus on the importance of having a curriculum appropriated to fit the new educational context, in which technology is not an isolated

skill anymore, but it is the basic tool for virtually all the other competencies that need to be built in the learning activities in schools.

Digital inclusion. Most of the participant responses to this research mention digital inclusion as being the knowledge of the use of information technology, as can be seen in Table 9. Inspired by the definitions of the University of Maryland about digital inclusion (University of Maryland, n.d.), this research used a broader set of elements than solely having IT skills to define digital inclusion.

- The resources: hardware and infrastructure (including Internet connectivity).
- The applicability: relevance and practical use of the information technology.
- The conditions: time and skills to use the information technology.

In this sense, digital inclusion is the result of the congruence of the above elements. Therefore, the teacher does not necessarily need the school to obtain digital inclusion. The resources might be private; the applicability might be related to aspects of the teacher's life other than the professional one; and the conditions might be obtained gradually, as long as the teacher has the resources and the applicability of the tablet computer.

For instance, when a teacher has already used social networks for personal purposes using a smartphone, he/she develops digital inclusion which boosts his/her engagement with the tablet computer project. Also, the skills developed through the use of other technologies, such as using a text editor on a desktop computer, somehow works towards improving the use of tablet computers. After all, the text editing software on a desktop is not very different from a blog posting with an online text editor.

Table 9

Examples of statements uttered by the participants on the Digital Inclusion factor

"The teacher's lack of technological knowledge inhibits their engagement with the project."
"Only those that previously had digital inclusion felt stimulated to adhere to the use of tablet computers in their classes."
"Equipping schools with technology is relatively simple, but on the other hand, it requires professionals who know how to use such technology practically in schools. The school needs to modernize, but rather must include the teacher digitally."
"Training only results in the digital inclusion if teachers put what they have learned into practice."
"Ideally, the teacher should learn to deal with technology in their teaching practice while still in college during their teacher training."
"The lack of digital inclusion makes some teachers feel embarrassed due to the gap between their performances compared to the student flippancy in the use of mobile devices. The students are the digital natives, whereas the teachers are digital immigrants."
"I only had success in the use of a tablet computer in my teaching routine because before I got a bachelor's degree in Geography, I already was a computer technician."
"We deal with teachers with very heterogeneous profiles in terms of digital inclusion. There are teachers that the only technologic tool they use is the email; others still can use a text editor or create a presentation by themselves. However, few of them can confidently use the tablet computer to set up some important online tools for their classes, such as a Facebook fan page, a blog in Blogger, or a YouTube playlist."

The problem is noticed when the teacher has little or no digital inclusion, i.e. when digital inclusion has not been acquired for private purposes and/or during college. Therefore, the failure of other factors in the tablet computer deployment can prejudice digital inclusion, which constitutes a barrier for teacher engagement with the project. Using the logic described above, the following examples of flaws can turn digital inclusion into an impediment for teacher engagement.

- Lack of resources: low-quality hardware, inexistence of Internet connectivity.
- Lack of applicability: the teacher is not informed about the advantages of using the

mobile devices for education.

- Lack of conditions: the training does not enable the teacher to use the tablet pedagogically; the principal does not afford extra time for the teacher to get training and pedagogical support.

The teachers who have skills in information technology are those that take up using tablet computers with some success. As much, they are digitally included the less they depend on school structure and support to adhere to “the project”, a common name used by the participants to cite the deployment, and reach success in the use of tablet computers. Unfortunately, there are teachers with a very low digital inclusion level, as the one mentioned by Neves & Cardoso: "I do not have skills, formation, and experience to integrate the tablet into my classes. I hope that the needed experience and knowledge be acquired during the training." (2013)

Another point written by Neves & Cardoso (2013) reveals another detail on digital inclusion that was detected in this study: "Even in schools where there is some activity based on IT, such as publishing of online magazines, the lack of digital inclusion between teachers generally is preventive for the reasonable use of tablet computers." It means some teachers have digital inclusion enough to make them work reasonably with some technology, but not necessarily in the context of tablet computer use.

Training. This involves any procedure needed to make the stakeholders, especially the teachers, able to handle the mobile devices and apply them in the classroom context. It is not by chance that the training was the most cited factor since it is the most important procedure to do after receiving the tablet computer. It is common sense that, once someone has a proper training, the results obtained from the use of the tablet computer tends to be successful. The opposite also is true, without proper training, the tendency is the obtainment of not satisfactory results.

There are different levels of management involved in the training, which varies from state to state. As the arrangement of the training varies from state to state, in general, those responsible for the training can be described as presented in Figure 16. The Ministry of Education (Federal Government) gives the directive for training the teachers engaged in the project. According to Hororato (2012), the Ministry of Education specified 360 hours of training to enable teachers to use the tablet.

The State Secretary of Education (State Government), in partnership with the local Federal University or working with its team, provides the training course for the core pedagogical and/or technical support teams from all over the state. As the number of teachers to be trained is enormous, there is a multiplication of the training courses through these teams.

The regional branches of the State Secretary of Education organize the schedule and logistics involved in the training courses provided by the technical and/or pedagogical teams to the teachers. Each branch manages the public schools spread out over one or more cities in a region of the state.

The principal of each school has to release the teachers to allow them to take part in the training courses, according to the calendar established by the regional branch of the State Secretary of Education. Sometimes it is a challenge since the time frame available for training the teachers is very short. In fact, there is little time in the school calendar for training purposes, which makes the online courses an attractive option for the policymakers but an undesired option for many of the teachers.

Unfortunately, during all of the data collection phase, almost all declarations in regards to training were negative, although this was the most cited factor to be observed in a deployment. Many of the participant survey responses cited the training factor, either mentioning it is

important for the deployment, or criticizing the lack of training to make the teachers able to use the tablet computers properly in the pedagogical context of a classroom.

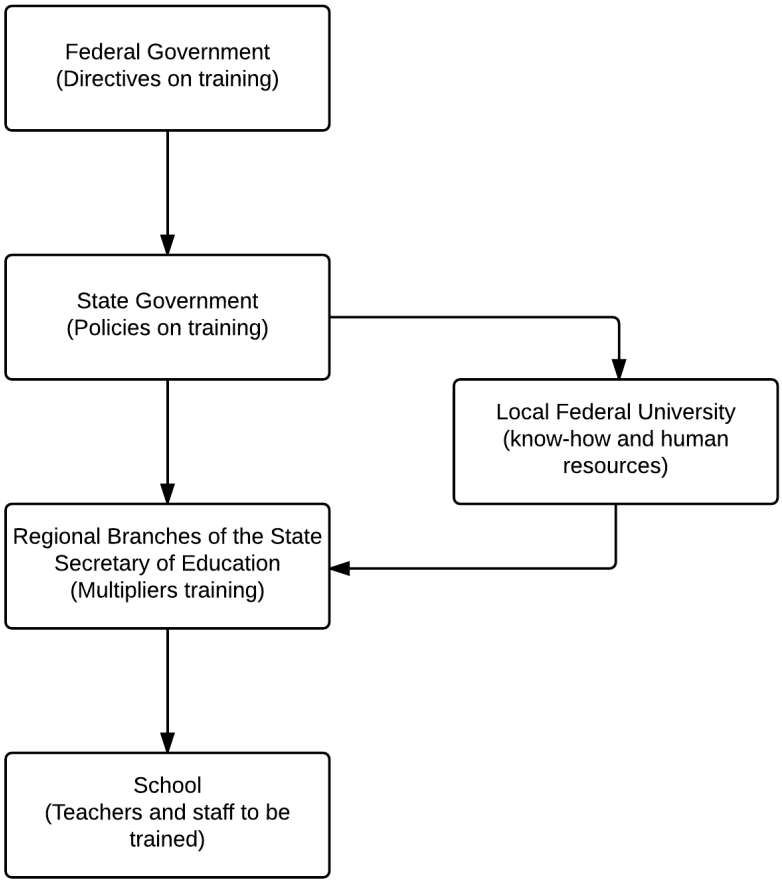


Figure 16. The management levels typically involved in the training process.

Table10 exemplifies some typical comments on the necessity of training for the deployment. An initiative that was planned while depending on so many stakeholders generated many problems. The delivery of the devices was delayed in some places, which forced the training to be postponed, whereas in other places they were delivered in time but the training did not take place after all. In some states, the teachers complained about the weak, fast track, and mostly online based training, which was restricted to starting up and unlocking the device, without any pedagogical approach to using the tablet computer. The principals of some visited

schools did not know how to use the device. The researcher asked some of the principals to demonstrate the tablet computer resources, and only a small number of them were able to do it, indicating the lack of engagement of principals of some schools in the deployment process.

Table 10

Examples of statements uttered by the participants on the Training factor

"The tablet computers were distributed with no training. That along with the difficulty to access the internet undermined the device's pedagogical function."
"First of all, they should provide training on how to use the tablet computer."
"Fortunately, we have a colleague that is very familiar with technology. He is the Geography teacher. Whenever it is possible, he helps us on how to use the device, although it is not his role here."
"The training was restricted to turning on and unlocking the device."
"I asked a high-level executive from the State Secretary for Education the reason we would not have a pedagogical training on the use of the tablet. Her response was 'When you buy a Galaxy Tab at the mall, do you receive a course from Samsung?'"
"There was no training at all, although it was announced in Brasília."
"The school managers need to be trained in the use of technology for education purposes in order not to create a gap between the curriculum and the technological resources available to support it."
"The principal of this school also took the training for using tablet computers in the classroom, and it made him help us to overcome most of the difficulties in using the tablets."
"The devices' arrival was delayed for some weeks, and the training had to be postponed until the next school semester."

The federal universities, which were announced as being the providers of training for the tablet computer deployment, had little or no participation in the deployment process in some states. The training to make the teachers master the use of tablet computers for their classes was performed mostly online (90%) in at least one state, with content based solely on video classes and PDF documentation. This fact made many teachers give up being trained in the use of the

devices for educational purposes. They expected better structure and longer training, especially those with little digital inclusion.

An exception to this negative picture was found in the state of Paraiba, in the Northeast of Brazil, where the Federal University of Paraiba had an active role in the training process for the teachers and support staff involved in the tablet computer deployment. They trained local technical/pedagogical support for all the 200 schools involved and 26 instructors to continue the training process after the deployment ends. These trained professionals were supposed to multiply the training in their respective schools, which involved 5,403 teachers. As a result of this training plan for that state, in one of the schools visited by the researcher (Elpídio de Almeida State School), the engagement with the tablet computer program is widely spread among those teachers who were supposed to use the devices.

Another good example was the public school of São João do Sul, a small city located in the southern state of Santa Catarina. At first, it was a surprise for the researcher to uncover the participation of a city school in the tablet computer project. In fact, not only the state schools had access to the tablet computer project, but any city school could apply to receive the tablets as well. The teachers interviewed there were satisfied with the training they had on the use of tablet computers. When interviewing the city district leaders, the secret of such success was unveiled. They had a very well skilled technical and pedagogical support team that did not depend on external training for the use of tablet computers. They developed their own training plan, according to their needs, their teacher profiles, and their limitations. The city educational manager not only was totally involved in the deployment process, but he was leading it in person. He had the skills needed to do it because he was an undergraduate student at the Federal University of Santa Catarina, in a course focused on technology in education.

When visiting one of the city schools, the researcher had the opportunity to see a class of special needs students taking a lesson on basic computing with the use of hardware specially designed for people with limited dexterity. The same pedagogical support team had developed a complete methodology to use that hardware (mouse and keyboard) for people with disabilities to teach them how to use an ordinary computer. It demonstrates that if they were able to develop a methodology and content to teach computers to people with disabilities, it is not by chance that they also were successful in training teachers in the pedagogical use of tablet computers.

The reality found in the city of São João do Sul was very different from all other places where the researcher had been for this research. Unlike in that small city, the initial project for the tablet computer deployment did not include any training in the deployment process (Maia & Barreto, 2012). According to the first plan, the policymakers believed that the teachers would receive the devices and find out the best way of using them pedagogically by themselves.

The training program needs careful planning to set it up properly since it involves lots of people, in different roles, departments, and institutions. Moreover, when it is well done, it enables teachers to engage in the project as well as foster the creation and the engagement of formal and informal leaders. The testimony of teachers spread out all over the country seems to indicate that there was minimal or no planning to manage the training process, thus, the training implementation faced problems in different states such as logistics, organization, and teacher adherence. The training outcomes were disappointing. They had a high dropout rate on the part of the teachers when the training had a long schedule. They did not have a high dropout rate when the training entailed a two-hour meeting. In both cases, the level of satisfaction with the learning process was, in general, very low.

Methodology. This factor is related to the know-how needed to use the tablet computer in the educational context. It may be expressed in the form of abstract knowledge from the involved professionals or in the form of lesson plans for using tablet computers to present some subjects in an enhanced way.

The insertion of the tablet computer in the classroom routine changes the way the teacher works. In this sense, Table11 exemplifies some typical comments and questions on the methodology needed to use the tablet computer productively.

Table 11

Examples of statements uttered by the participants on the Methodology factor

"Why should someone watch a 50-minute lesson if it is available on the Internet?"
"Most of the content from the Portal do Professor [Teacher's Portal] that I had an interest in using for my lessons were not compatible with tablet computers; they are only available in Flash format."
"The lack of pedagogical planning forces the teacher to fill the tablet computer with many apps; most of them are useless."
"We have to develop successful methodologies to use tablet computers in the classroom. It is still a question whether the students should be allowed to use mobile devices as well. Otherwise, the teacher will compete with the Internet for the student's attention."
"How can I foster the use of mobile devices in the classroom if there is a state Law in São Paulo which prohibits the use of cell phones in the school?"

The students we have today are quite different from the students for whom our educational system was designed. The design was made for the generation X, but we are dealing with the generations Y and Z nowadays (Bump, 2014). In the context of the tablet computer use in the classroom, "the teacher does not need to focus his/her attention to transmit information but also to make them available, to manage student's activities, and to mediate each step of the didactic activities" (Moran, 2003, by Videira, 2015). "It is not just a matter of having a

classroom with technological devices; it must consider that this process requires a change of educational paradigm" (Maia & Barreto, 2012, p. 54).

It is important that the teacher master the use of tablet computer in the educational context, i.e., to effectively use the device for teaching purposes. However, knowing how to operate the device and its tools is not enough to reach the expected pedagogical outcomes from its use. It has more to do with methodology, training, curriculum, documentation, and experience. The teacher must master the methodology to use the tablet computer in the classroom, either based on documentation that comes along with online educational resources, as in the content available in the Portal do Professor [Teacher's Portal], or supported by the pedagogical support team. Once this happens, the teacher is enabled to modify other's methodology or create his or her own. It allows the teacher to contextualize the use of a tablet computer into an infinite set of teaching possibilities.

Mastering the methodology for using tablet computers is such an important factor that it was the second most coded category in this research. Furthermore, the Training category was the most coded one in part because the teachers complained about the training precisely because it did not enable them to master the methodology of using the mobile device for their work.

Content. This factor is related to any published content available for teachers, as well as the content generated by teachers to be used by others. It means that any element used for transmitting information to the student was considered content, such as an app, a document, or any online resources, such as videos, blogs, and forums. It also included any legal issues that the teacher must master to deal with content copyright. Table12 lists some statements uttered by the participants on the factor of Content.

Table 12

Examples of statements uttered by the participants on the factor Content

"I would like to have regional apps available for my classes, with content related to my region."
"I do not use all the content I find on the Internet because I am afraid of violating some copyright and getting involved in a legal problem because of it. I guess it would be a good idea to provide training on copyright themes so that teachers feel confident using random content they find on the Internet."
"We need to have the lessons ready to use. I do not have time to develop the content I need to use with the tablet computer. I already work too much, teaching classes all day long. It is not fair that I have to use my spare time to work still some more on this project."
"We did not have any training on the use of the available content on the Internet."
"I am not paid to develop content for teaching. I need to have ready-to-use content for the tablet computers."

The tablet computer was handed to the teacher with a set of pre-installed educational resources: TV Escola (online video streaming service with school content), Revista TV Escola app (an online magazine with educational content), a drawing app, open office suite app, Google Maps app, Gmail app, among other Google apps for Android. The user manual also was available on the front page.

The federal government had announced that the tablet computer project would count on the "Portal do Professor" (Teacher's Portal - http://portaldoprofessor.mec.gov.br), which is a repository of open educational resources (Mercadante, 2012). In order to access it, any teacher, from any country, can register and access the repository. Once logged on the website, the teacher has access to lesson plans, science experiment outlines, multimedia content, links to external resources (especially videos), and still can interact with other teachers (in Portuguese). Any teacher may submit content to be published on the teacher's portal. The content goes through an assessment and might be returned with some requests to meet the minimal quality standards of

the portal. Once all the requirements are met, the content is published under various license models, including public domain and General Public License (GPL).

At the time the tablet computer deployment was initially announced by the Federal Government, the teacher's portal had 16 thousand OER's available (Portal Brasil, 2012). However, since then, the Federal Government has been working to increase this number of OER's, including the partnership with Khan Academy to translate all its content into Portuguese (Paraguassu, 2013).

The researcher explored the teacher's portal and found a great diversity of content, regarding the subject, the format, and the quality. There was content related to a very large number of lesson themes in all school subjects, either in PDF, HTML and FLASH formats. Some of them are very well structured, with all the expected elements of a pedagogical plan, such as objectives, justification, methodology, and assessment questions. Others are not put together as well in terms of the lesson plan. The end product varies as well, from the text-based PDF or HTML obtained from an ordinary text editor, to material with animations, and a very well designed user manual in PDF. In sum, the teacher's portal is yet another OER repository found on the Internet, with content in Portuguese and Spanish, although the official and only language spoken in Brazil is the former.

Unfortunately, most of the coveted educational resources found on the teacher's portal are not compatible with tablet computers because they are based on Flash technology. As claimed by some teachers, the website is not friendly regarding usability. It is not easy to find specific educational resources because the website has a confusing navigation system, its search engine is very simple, and it does not allow any filtering.

Some teachers complain they need to learn how to deal with copyright issues to feel confident about using content from the Internet without breaking the law. However, it seems that the participants in this research did not have the opportunity to look for instructional material on copyright laws on the teacher's portal. This researcher searched the internet and found 190 resources on copyrights. One of them, was produced by the Ministry for Education, and was very complete, with all the information needed for a teacher concerned with copyright issues. It demonstrates that a problem stated by the teacher does not necessarily correspond to reality. In any case, awareness about copyright laws is an important aspect to be covered in any deployment program.

Further, many teachers stated that there was no content available for their lessons. Considering that there is a repository of open educational resources available and online resources integrated with apps pre-installed in the handed tablets, the researcher asked the research participants about this facility. According to their responses, the teachers did not have the proper training to take advantage of such online resources. The repository policy allowed the teachers to download any content, change and adapt it to their teaching needs since it is not for commercial purposes. However, they were not keen to develop their content, even though they do not need to do it from scratch.

The technical support staff stated that the teachers prefer to use PowerPoint slides available on the Internet in their classes rather than producing their own videos or slides. Some of them even expected the technical support staff or the pedagogical support staff to make the arrangements for them so that they did not need to produce anything themselves for their lessons. The teachers thought that producing their content was too much work and that it demanded too

much of their free time. The low salaries besides the lack of training and infrastructure discouraged them.

As it can be seen, having content is an important factor for the teacher's engagement with the project. Furthermore, besides being a didactic related issue, the Content factor regards methodology, work policies, training, and dissemination of the paradigm and its best practices.

Technical support. This factor regards any action or resource dedicated to helping teachers with the use of IT resources or to solve problems concerning technological aspects of the use of tablet computers or related equipment. Table13 exemplifies some typical comments on technical support.

Table 13

Examples of statements uttered by the participants on the factor Technical Support

"I need constant help from the technical support to overcome my lack of intimacy with the device and its resources. The learning process does not have a sharp curve; we need time to master the tablet computer, along with much support and patience."
"The teacher who is the techie guy here is awesome, very helpful for us to overcome our difficulties with the technology. However, he is only one person, with other duties, including teaching classes as well. It is not possible to have more dedication from him."
"Some teachers need more time than they have to put into practice the use of the device, others are not keen to 'waste' time practicing with the device, and they do not think it is worth it. Then, they do not look for our assistance."

The human resource that takes care of the infrastructure is another important point. In several schools, there was one contractor that handled technical support. The turnover of the support staff was very high compared to the other roles in public schools, because when contractors found a better job, they simply left the school, impacting the school routine very negatively. In some small schools, the technical support was likely a "techie" teacher that needed to share his/her time between the teaching activities and technical support demands. The lack of

professional and stable technical staff prejudices the technical infrastructure management as well as the tablet computer deployment.

It is much better when a school has an IT professional not only to take care of the technological resources but also he/she is a formal leader, an IT advisor for the school principal. The result is a school with more and newer IT equipment, better installations to support technology, better utilization of the IT resources and teachers that are more confident in the use of technology for pedagogical purposes. This happens because the IT manager can follow up more proactively the applications for new equipment from the state and federal governments, better handle maintenance contracts and facility reforms, besides providing technical support for teachers and staff. This optimized scenario was found in São João do Sul (state of Santa Catarina) and Campina Grande (state of Paraíba).

More than just managing the technical property of the school, the technical support runs a continual process of the training regarding the tablet computer. The teachers count on them to solve post-training questions, especially with regards to the online part of the training. The in-person demonstration of some procedures available on online videos is important for those teachers that have low digital inclusion.

Pedagogical support. This is related to any action or resource dedicated to guiding the teacher on the pedagogical use of technology in education. Table14 exemplifies some typical comments on pedagogical support.

Since, in some schools, the technical support and the pedagogical support were merged into the same staff, it is important to differentiate the two in relation to the expectations from the teachers in the tablet computer deployment. Technical support provides help to teachers with regards to the technological gadgets, hardware, procedures, protocols, and resources. The

pedagogical support provides help with regards to the use of technology specifically in the context of teaching, such as pedagogical plans and strategies, suitability of use, and expected learning outcomes. The technical support needs to have a deeper knowledge of technical aspects of the technology with fair know-how on the teaching context in which the technology is inserted, whereas the pedagogical support needs the opposite, focusing more on the pedagogical context and more superficially on the technical details of the technology. Seldom does a professional have excellent performance in both approaches at the same time.

Table 14

Examples of statements uttered by the participants on the factor Pedagogical Support

"I do not feel self-confident about changing the way that I present my classes with the introduction of the tablet computer."
"There must be new lesson plans to include the activities that can be done with a tablet computer. It demands a lot of pedagogical support from the school pedagogues and the Educational Technology Centre."
"The tablet computers were delivered to the schools in our region right before the beginning of the semester. How could we train and support the teachers in the use of tablet computers after the semester started?" (Pedagogical supporter)

Some teachers do not feel confident in developing pedagogical plans, building content, or even modifying these elements from something ready to be used and modified. They count on the pedagogical support provided by pedagogues that each school has in its staff and by the Educational Technology Centres (ETC).

An ETC is a division of the State Secretary for Education focused on disseminating the use of educational technology in the schools. The structure of the ETC varies according to each state, but there is one ETC for each regional branch of the State Secretary for Education, see Figure 16. The ETC staff is composed of former teachers, pedagogues, and technicians with

extensive experience and/or certification in educational technology. They count on a physical structure and equipment to provide lectures, courses, and workshops for the teachers and pedagogues of the schools that belong to the area of operation of their respective ETC. As the multipliers of educational technology know-how, they are the people that officially disseminate the procedures and methods to be used for the deployed tablet computers in the schools across each state.

In general, the ETC supporters have the know-how to work autonomously in jobs related to relatively well-known technologies such as educational software and productive software for desktop computers, and peripheral equipment (projectors and interactive whiteboards). However, at least in some states, they do not have the critical thinking to develop methodologies applied to new paradigms like the one represented by the introduction of tablet computers in schools. They need to follow guidelines and receive training from other instances of support, such as the staff of the State Secretary for Education, hardware or software providers, or university professors.

Therefore, there is a pedagogical support chain, which involves teachers that get support from the pedagogues, which together get support from the ETC that, in turn, gets support from superior consultants from the government, suppliers, and the University.

In the case of tablet computer deployment, this pedagogical support involves not only what is related to the mobile device itself, but also the content with which it is supposed to be used. As each state can define its curriculum, the pedagogical supporters also have the duty to fit its actions within the curriculum limits defined by each respective state.

As long as the teachers do not necessarily find the expected pedagogical support from the pedagogues and the ETC staff, some of them end up becoming informal supporters for the others, especially those that have a higher level of digital inclusion.

Policy. This factor regards the procedures that aim to establish operational rules and protocols for the use of tablet computers in the school context. Table15 exemplifies some typical comments on the Policy factor. In fact, this factor represents the set of different policies ruled by different managerial instances involved in the deployment. This means that there are policies for hardware use, curriculum, content, and maintenance, ruled by the Federal Government; for dissemination and training, ruled by the State Government; and for infrastructure and human resources (technical support and pedagogical support), ruled by each regional branch of education and each school.

Table 15

Examples of statements uttered by the participants on the Policy factor

"The tablet computers have been used mostly for entertainment. The teachers that receive the device need to follow a user policy driven by the enhancement of his/her classes."
"There should be rules for a more valuable use of the tablet computer and its related peripherals by teachers."
"The lack of pedagogical planning causes the teacher to fill the tablet computer with many apps; most of them are useless."
"With the same expenditure, it would be more useful to us if we had received four or five big screen televisions rather than just one sophisticated interactive whiteboard."
"There is a state Law in São Paulo that prohibits the use of smartphones by students and teachers inside schools regardless of the purpose."

The plan developed by the Federal Government has not had any standardization for all the needed policies to rule its practical aspects. The timing for device-distribution varies a lot, even for schools in the same state. The training policies depend on each state, which produces a great variety of methods, timing, and outcomes. In terms of dissemination of the paradigm, there are states that treat the tablet computers as ordinary technological equipment and do not have a special communication with the stakeholders. Other states have a very sophisticated

communication strategy, counting on a website as well as on an internal newspaper to communicate information about the procedures, advantages, and expected outcomes of the use of tablet computers in schools. In their turn, the schools also have a great variety of policies; depending on the structure and staff they have available to run the tablet computer project. In some visited schools, the temporary teachers (contractors) did not have the right to receive tablet computers a priori. However, due to the lack of interest from the regular teachers, many of them could receive the remaining devices. In sum, although the existence of policies to rule the deployment shows how important they are for the success of the project, in some states it is the reality that delineates the policies, not the contrary.

Leadership. This factor involves the emergence of formal and informal leadership, as well as the engagement of these leaders in the deployment process. When the deployment counts on an engaged leadership, it is easier to overcome the difficulties that come up with it. Some of these difficulties are depicted in the examples presented in Table16 below.

Some principals do not care if there is little or no adherence to the tablet computer deployment process because it masks another problem, which is the lack of infrastructure. If many teachers adhered to the use of tablet computers as the policymakers advocate it, there would be a shortage of classrooms that could support the use of multimedia presentations and supportive equipment, such as interactive smart boards, projectors, and televisions. The proactivity and networking of some principals make all the difference regarding infrastructure available in the school because they are the interface between the school and the higher-level administration. Therefore, it is clear that the school leadership must be committed to the deployment and not let the project to fail because of the local reality.

Table 16

Examples of statements uttered by the participants on the Leadership factor

"The principal of this school also took the training for using tablet computers in the classroom, and he was able to help us overcome most of the difficulties in using the tablet computer in the classroom."
"The principal of this school does not care whether or not the teacher adheres to the project. He would find it splendid if most of the teachers did not adhere. After all, if lots of teachers start using the tablet computer for class presentations, he will need to get new projectors, reform some classrooms, expand the Wi-Fi signal, and so forth. As it will not be possible in the short term, he will have a problem to solve with the teachers. "
"The teacher who is the techie guy here is awesome, very helpful for us to overcome our difficulties with the technology."
"Having the equipment in the school is not enough to use it. The commitment of the school principal or manager is fundamental to the success in the use of the technology. He is the student's partner who is essential in implementing superior teaching methods for them."

The informal leadership also greatly influences the outcome of the deployment, as long as these leaders are important for the dissemination of the new technology, according to the concepts presented by Hall and Khan (2002), cited in chapter 2. It was clear that the more the leadership is trained on the use of technology, and it acquires digital inclusion, the more it influences the leadership towards a successful deployment.

Dissemination. This factor is related to the dissemination of the paradigm and the potential outcomes from the use of tablet computers in schools, besides the needed structure and attitudes to get results from it. The deployment should involve all stakeholders, such as policymakers, managers, principals, teachers, support teams, and even students and their parents. Therefore, dissemination strives to inform about the tablet computer's advantages, procedures, and possibilities regarding learning outcomes. Ultimately, within the tablet computer deployment

herein studied, it results in convincing the teachers to engage in the project. Table17 contains three comments on the Dissemination factor uttered by the participants.

It is very easy to identify the impact of the dissemination of the use of tablet computers in the teacher awareness. In the states in which there was a more organized and structured communication at work, the participants demonstrated that they are more conscious of the advantages of using the mobile devices in the classroom.

Table 17

Statements uttered by the participants on the Dissemination factor

"They did a good job in terms of tablet-computer 'catechism.' We were informed about what was going to happen, the device, the structure that we needed to count on, and so forth. In the end, they lacked some of the prerequisites they had taught us about. Anyways, it was important since we were aware of what we needed and so we could demand from them the Wi-Fi connectivity, the projectors, and the cables."
"We developed a guidebook to clarify all the questions from the principals, pedagogues, and teachers on the tablet computer. We had our own content repository to publish the content needed for the teacher to use the tablet computer in the classroom. All the content came with their respective teacher manuals as a guide on how to use them for lessons. After that was done, we visited the schools to lecture about all these recourses before the devices were handed out to the schools. When the devices arrived at the schools, everybody there was aware of the resources they had to work with them. As long as we had the first teachers adhering to the project, we published reports on the outcomes resulting from it, in order to stimulate other teachers to adhere as well. "
"We have produced some videos and published them on YouTube to clarify some frequent questions, such as how to unlock the devices or how to use some of the installed applications. It was very helpful in terms of reducing the demand for technical support and increasing the teacher adherence to the project."

Two state policymakers and a teacher mentioned this factor. This last one was contacted to confirm the dissemination process declared by the senior executive of a State Secretary for Education. Although there were so few codes related to Dissemination, the importance perceived

about this factor for the deployment made the researcher keep it separately from the other factors and include this factor in the deployment model presented in next chapter.

Teacher engagement. This factor is related to teacher engagement with (or resistance against) the activities needed for the use of tablet computers in the pedagogical or operational contexts. This means more than simply adopting a technology but also getting engaged with the work process needed for the teaching paradigm change, such as getting trained on the technology, using the tablet computer, using and producing content for the device, disseminating the devices' use, and enhancing the teaching methods based on the use of tablet computers. On the other hand, the resistance against the use of tablet computers also is related to the Teacher Engagement factor since it indicates that the reason for the resistance is also important to be considered for the deployment.

In fact, there are many examples in the literature exposing the teacher's resistance to getting engaged with to the use of tablet computer in their teaching methods. Neves & Cardoso (2013) report a teacher's declaration in which he says:

> "My subject matter does not have much space for technological resources. Philosophy is transmitted through texts and writing. The computer does not add much. What matters for the student is reading and writing. That is what the student needs. It can be done very well with the use of printed paper."

Maia & Barreto (2012) go still further when they state:

> "The teachers were focused on solving problems related to bureaucratic activities with the tablet computers, to make them easier to handle. They did not have the understanding of the search for new pedagogical resources for teaching aligned with new technologies. The

teachers do not want to change their way of presenting a class. The tablet computer would demand differentiated pedagogical plans."

The opposition of teachers for adhering to the project, mentioned in Chapter 2 and reinforced by the references above, was confirmed by this research. In a single school in Santa Catarina for instance, the teachers returned sixteen out of eighteen received devices without any justification. In a meeting with all the group of teachers and pedagogues of this school, the researcher asked the reason for such resistance against the use of the tablet computers. The response received from several teachers included almost all the factors presented so far in this chapter.

The other factors do not complete the set of reasons to influence the teacher engagement. The teacher's own interests and attitudes also justify the lack of adherence to the project, regardless of the hidden conditions for the lack of interest in participating in the deployment. Table18 exemplifies some typical comments on teacher engagement.

Table 18

Examples of statements uttered by the participants on the Teacher Engagement factor

"Many teachers simply returned the devices just after formally receiving them from the school, with no justification."
"Sometimes, the teacher enrolls in training just for career advancement, not because he/she is interested in learning new teaching methods or mastering new technologies." (Principal)
"The teachers fear the tablet computer because it can threaten their position as 'the owners of knowledge,' besides the fact that it forces them to get out of their the comfort zones."
"I cannot see any pedagogical application for that device."
"The teachers that really adhere to the use of tablet computers end up enjoying the advantages of it, but they are the minority because of the lack of school structure and the poor quality training."

The teacher might have many reasons for not adhering to the Brazilian tablet computer deployment, which all the factors described so far in this document give justifications for such an attitude. However, as can be seen in Table18, the teacher engagement itself, regardless of any other factors, also is an important factor to be considered for the deployment. In fact, the teacher engagement was considered the most crucial factor for the tablet computer deployment since it does not matter how perfectly all the other factors are provided for the teacher, if there is no will to engage, the whole deployment process is jeopardized. As shown in Figure 17, teacher engagement is the element that integrates the initial planning intents and all the actions that come after that from the effective practice of what is planned by the education policymakers. In other words, the deployment process studied in this research starts with the planning performed by the policymakers and culminates with the teacher engagement with the use of tablet computers in the classroom. There are many other factors to be considered, but without teacher engagement, the tablet computer is not incorporated in the teaching process in the classroom, and no learning outcomes can be obtained from all this effort. It is important to notice that, at the same time that teacher engagement is a factor that influences the deployment as a whole, it is the goal of the deployment. In sum, the Teacher Engagement is the bridge between the deployment and the effective use of tablet computers in classrooms.

It is important to mention that the teacher engagement was considered the most important factor for the deployment process as a whole, even though it was not the most mentioned factor during the research participant interviews.

Auditing. This factor involves all procedures related to auditing the use of tablet computers by teachers. Although the tablet computer is distributed among teachers for free and without any restrictions, there is no audit policy to follow up on their use by teachers. The only

restriction the teacher has regarding the device is returning it in case he/she leaves the school for which the tablet computer was bought. This loose policy has provoked some reactions from those involved in the deployment process. Some of these reactions are narrated in Table19 below.

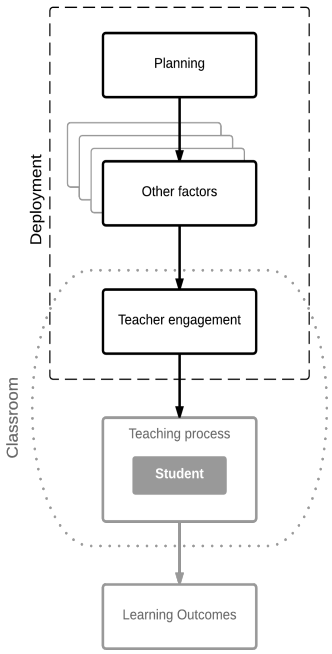


Figure 17. The tablet computer deployment seen as a process which starts with planning and ends with teacher engagement.

Table 19

Examples of statements uttered by the participants on the Auditing factor

"The teachers need to be subject to an audit in order to check if the training they had participated in had a practical impact on their teaching methods. Less than half of them finish the training."
"If you, as a teacher, accept a tablet computer with the goal of improving your teaching process, somehow the use of the tablet computer you received for free needs to be audited."
"We cannot wait for the learning outcomes as the only way to evaluate the quality of tablet computer usage. It takes too long… years. We need to observe how the devices have been used to disseminate the recommended practices and restrain the ineffective usage."

Once there is a grant of a technological resource to be used personally and professionally by the teacher, it would be normal that the grantor checks how the technological resource is being used and what the results are from using it. However, there is no public document that indicates that any form of audit has ever been done in the Brazilian deployment. Neither was any of the contacted participants ever aware of or informed about any supervisory actions from the federal or state governments.

Despite the apparent inexistence of any audit procedure beyond the device possession by the teacher, the participants indicate that it is important for the deployment. The leaders must have auditing tools to check whether or not the tablet computers are being used for the purposes they were intended for. Further, the methods for using the devices must be assessed to correct improper practices and to disseminate the suitable ones. This factor is also useful for checking the validity of the investment done so far on this kind of technology and drive new investments that will occasionally be considered in the future, such as tablet computer upgrades and purchase of new peripherals.

Planning. It is the last factor listed here, but it is related to the beginning of the deployment process. Planning is a factor related to any action, especially for a project of this scope in order to organize the resources and procedures towards its success. Table20 shows some comments in this factor.

As indicated in the declarations in Table20, this researcher found some breaches in the project for deploying the tablet computers. The policymakers in the Federal Government did not attend to some critical details related to the deployment, and it generated some of the problems reported in the other factor's narratives. They did not take training as significantly as it should have been taken and it had an effect on the perception of the participants on this factor. It is not

by chance that they did not plan any training at first, according to Maia & Barreto (2012). In fact, it seems that the pedagogy was not taken into account to plan the project. Costa & Machado (2012) reported some problems in the planning for deploying the tablet computer.

- The distribution of the devices took place without any pedagogical plan to put it into practice. This part of the planning was left to be detailed by each state of the Brazilian federation to develop it during the practice of using the tablet computers.
- There was only one public hearing to address the tablet computer project, in August of 2011. However, the focus of the hearing was just the technical specification of the hardware to be bought. No pedagogical aspect of the use of the mobile devices was discussed.
- There was no pilot project in the plans of the Federal Government to test the aspects related to the large-scale deployment involved in distributing 600,000 tablet computers across a huge country. The few initiatives implemented in this sense were performed by the states after the purchase had taken place. This was the case of the pilot project which ran in the Amazonas state (SEDUC/AM, n.d.), Minas Gerais (Ventura, 2012), Rio Grande do Sul (Bulco, 2012), and Paraná (SEDUC/PR). None of these pilot projects follow the recommendations of Bassi (2010) in regards to feasibility and replicability. "The feasibility of any given project determines whether that particular set of technologies is applicable in a given context irrespective of the inherent benefits" (Bassi, 2010, p. 19). The pilot projects were mostly performed in schools located in the capitals of the States. This inserts a bias in the pilot project results and compromises it since the reality of schools located in small cities, distant from the capitals, is quite different from the metropolitan schools. This concentration of experiments around the state capital also

harms the replicability of the pilot project, since the chosen sample does not represent the whole set of schools. It results in a less standardized solution to fit in all schools across the state.

Table 20

Statements uttered by the participants on the Planning factor

"They forgot to include in the technical plan the cables that link the tablet computers to the projectors. The teachers needed to buy cables with their own money."
"They announced that the training would be given by the federal universities, but I guess the people from Brasília forgot to make an agreement with them first."
"I do not think they have to run a pilot for this project. There are too many gaps regarding details to put the plan into practice for distributing the tablet computers."

The bulk of the planning, which should have been developed by the Federal Government, was instead done by other managerial instances, such as the State Government, the federal universities - which have administrative autonomy - and the school administrations. This planning decentralization, coupled with the relatively fast pace with which the project was implemented, generated some of the problems narrated by the participants in regards to other factors. Because of it, Planning is not only considered an important factor to be considered in this kind of deployment, it is the initial factor to be observed.

Participation Profiles

The data analysis identified different profile groups among the participants according to the grade of importance they give to the factors listed above. This importance is not only based on the number of codes generated by each group but also on the narrative obtained from them regarding the factors. Consequently, the discernment between these groups was useful to

establish the importance of each resulting factor (or category) based on the number of codes related to them, as well as based on their narratives on the deployment.

In fact, coding is just an interim product in the Grounded Theory practice, and it is not the only one, there are the memos written during the analysis. “And there’s a substantial distance that must be traveled during analysis between the time codes are generated and the end result.” (Grinter, 2010)

These profiles were named as being Policymakers, Managers, Teachers, Support Staff, and External Participants. Next, there is a description of each one of these profile groups with the analysis of their respective narrative, and some additional comments extracted from the memos.

Policymaker. The participants considered policymakers were those that declared they were district managers in the online survey or, during the visits, and were identified as high-level staff in the hierarchical structure of the visited state secretaries for education. The main concern expressed by the policymakers regarding codes was related to the Methodology factor, while Training was the most mentioned factor, by far, when considering the participants in general. The narrative of the policymakers is quite different from the average comments not only because of number of codes generated by them, but also because of their comments. They give an outstanding importance to a factor that had the lowest number of codes: Dissemination. Their narrative has more emphasis on the factors such as methodology, dissemination, and content, than those factors that are more directly related to the school reality, such as infrastructure, technical and pedagogical support, and hardware. Their narrative was important for the construction of a model that represents the deployment process.

Manager. The participants with some formal leadership in the local structure of the school were considered managers, which included principals, vice-principals, and pedagogical

coordinators. The participants with this profile were more concerned with the local issues related to the deployment, such as hardware, infrastructure, staff for supporting the teachers, and training. They expressed the local problems they had to face because of the advent of the tablet computer, especially in regards to infrastructure and hardware quality.

Teacher. The teachers focused their narrative mostly on training, which is indicated as the main factor for teacher engagement with the project. However, other factors, directly linked to their teaching practice were at the top of their concerns: hardware, infrastructure (especially Wi-Fi connection), and ready-to-use content.

Support staff. This group was composed of technical support staff, pedagogues who provide the pedagogical support for the teachers, and trainers. They are the professionals that work closely with the teacher and the classroom, especially the technical support professionals. Consequently, they have a differentiated view on what happens in the spearhead of the deployment process. Because of this, they were the most critical towards the teacher's attitude about the tablet computer project, and they had very emphatic comments about teacher engagement, highlighting the need for auditing as a form to obtain a more qualified teacher adherence to the project and better pedagogical results. Besides the teacher engagement, their narrative was concentrated on training, infrastructure, content, and hardware.

External professionals. These participants, along with the policymakers, are those that work at a distance from the main deployment scenario: the school. They are service providers, consultants, and researchers, indirectly related to the deployment process since they do not take part in the day-by-day routine of the schools that received the tablet computers. Their main focus is on the methodology, followed by training and teacher engagement. As they are not in the school routine, their vision over the deployment might seem distorted, but it is not. They have a

differentiated but still valid opinion on the importance of the factors that surround the deployment as long as they are specialists in their respective fields and have the critical view needed to identify the factors and narrate the relationships between them.

Chapter 5 Conclusion

This chapter presented the identification data for the participants in this research to clarify that no trace of the participant profile has a tendency to create some bias in the responses obtained during the data collection. Most importantly, it presented the main factors to be considered for the large-scale tablet computer deployment in Brazilian schools, which comprise the response to the main question for this research. For each factor, this chapter exemplified representative narratives of the participants. Furthermore, it included the memos written during the data analysis, which depicted the relationships between the elected factors. Therefore, this outline of the relationships between the factors represents the answer to the first research sub-question.

Thus, this chapter contains the information that helped the researcher to answer the second research sub-question, related to elements or procedures that could be added to the deployment in order to improve the process and/or mitigate problems. Furthermore, this information added to the profile groups' narratives, described in the previous section of the chapter, allowed the researcher to answer the last research sub-question, related to the model for describing the factors and their relationships that guide a large-scale deployment of tablet computers in a high-school system. The second and last sub-questions have their answers presented in Chapter 6.

Chapter 6

LARGE-SCALE MOBILE DEVICE DEPLOYMENT MODEL

The Large-Scale Mobile Device Deployment (LSMDD) model is the culmination of this dissertation. It is based on the analysis of the participant responses in regards to their coding and the interpretation of their narrative, with the identification of the most important factors to be considered in a large-scale mobile device deployment in schools. The description of the LSMDD model presents information that can give the stakeholders some direction about the elements or procedures that could be added to the tablet computer deployment in schools to improve the process and/or mitigate problems.

Model Design

The LSMDD model is presented in Figure 18. The deployment that it describes follows the logic presented in Figure 17. The LSMDD model was designed based on the Brazilian large-scale tablet computer deployment in public schools. The researcher took into account what the research participants, who had or have some relationship with the deployment, consider important factors for the process. The participants highlighted these factors whether they had a positive or a negative impression related to the factors in the Brazilian deployment. However, regardless of whether the narrative was positive or negative about each factor, the impressions of the participants reveal what matters for deploying the tablet computers on large scale in schools.

The model begins with planning, which is the starting point of the deployment process since planning is a procedure that naturally starts up any complex process. The model ends with teacher engagement, which is the goal of the deployment as a whole. It does not matter how well done was the planning, support, training, or any other factor involved in the deployment, if the

teacher does not embrace the idea of using tablet computers for his/her classes. As long as the teacher engages the use of a tablet computer, the deployment may be considered successful.

The legend located alongside the model describes the kinds of factors that compose the deployment, which are classified as follows.

- Method factors – those associated with knowledge about doing something necessary for the deployment process, or the result of it: auditing, dissemination, policy, curriculum, and methodology. The method factors are represented in oval-rectangular shapes in the model. Notice that planning is a method factor since it is a result of the application of knowledge.
- Structure factors – those associated with the physical and technological resources needed for the deployment: hardware, infrastructure, content, and maintenance. The structure factors are represented in hexagonal shapes in the model.
- Personnel factors – those associated with human resources and their features, such as support teams, training, and digital inclusion. The personnel factors are represented in rectangular shapes in the model. Notice that teacher engagement is a personal factor since it is associated with the human behaviour.

Appendix F shows an alternative format to present the LSMDD model, highlighting the classes of factors explained above.

The factors are linked either by single arrows, which indicate the direction of the influence of one factor over another or by two-side arrows, which indicates the linked factors that influence each other. The type of influence is indicated by a relation descriptor written at the beginning of the arrow. It means that the influencing factor is the one which the relation descriptor is closer to. In the case of two-sided arrows, there are two relation descriptors

separated by a semicolon. The first relation descriptor indicates the influence that the closer factor has over the other one, while the second relation descriptor, after the semicolon, indicates the influence the more distant factor has over the closer one.

The relation descriptors vary according to the influence that each factor has over another, but some verbs are recurrent, such as “stimulates”, “improves”, “boosts”, and “enables.” These verbs demonstrate the grade of importance that the factors have over teacher engagement, according to its level of assertiveness. For instance, when a factor “enables” teacher engagement, it means that this factor is essential. The same does not happen when a factor just “stimulates” teacher engagement; it can be dismissed without necessarily compromising teacher engagement.

The Hardware factor has an icon of a tablet computer positioned alongside just as a reminder that the factor is related to the object that was the origin of the subject of this study.

Description of the Model According to the Factors

Below, the factors mentioned in the last chapter are presented again in the context of the LSMDD model.

The planning factor. The model description starts with the initial step, the Planning. It must include all of the most important variables needed for the deployment between it and the Teacher Engagement. It means that at the very least, all of the factors described in this dissertation should be considered for a deployment plan. As the plan developer is far from the deployment field, which is the school, the plan is composed at a certain level of abstraction. It guides the set of policies that will rule the practical aspects involved in the deployment with a lower abstraction level than the plan.

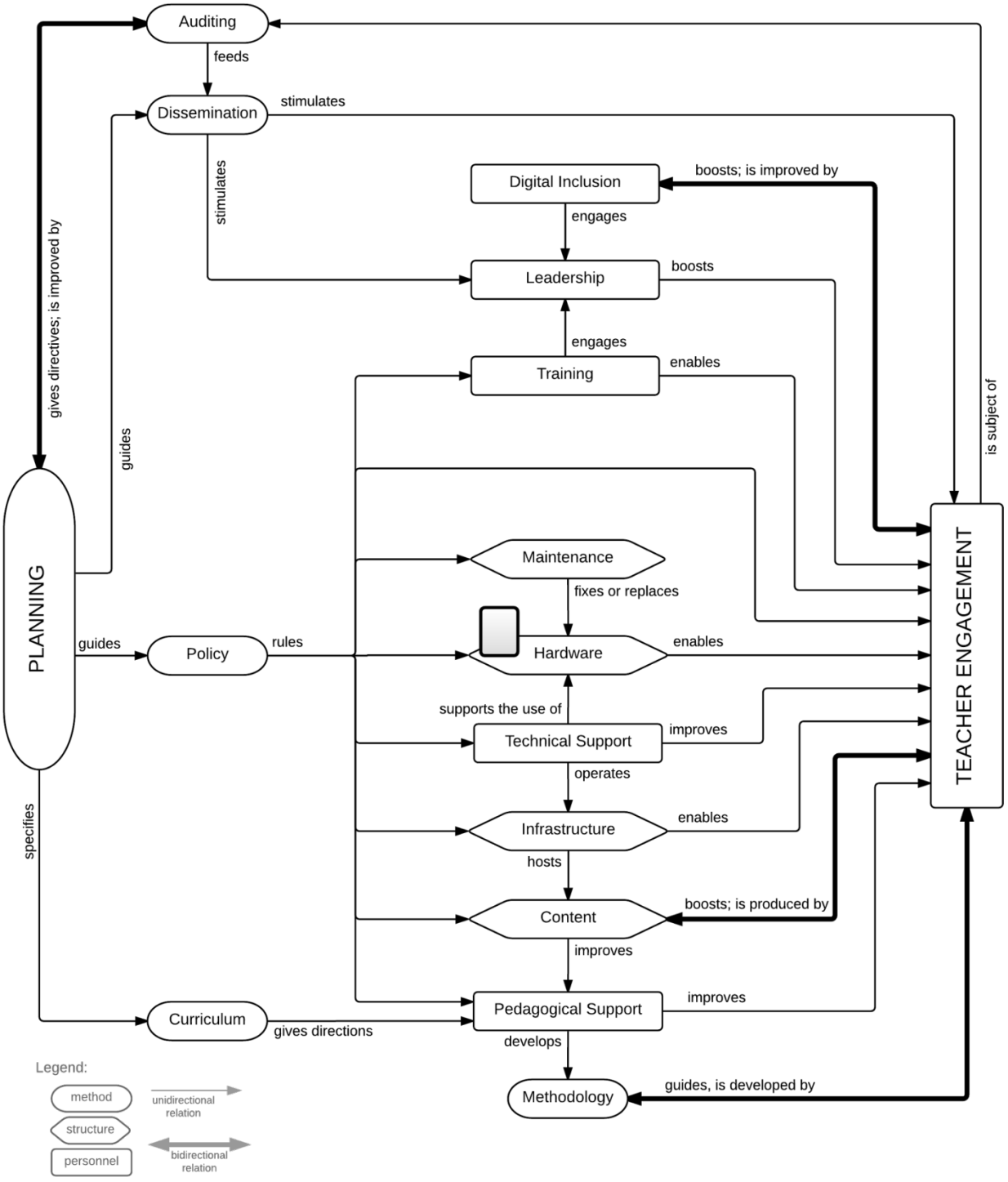


Figure 18. The Large-Scale Mobile Device Deployment model.

Notice that the sequence of factors described here does not have necessarily a temporal approach, notwithstanding this sequence follows the timeline always it is possible. It starts with planning because normally it is the starting point of any project, and ends with teacher engagement because this is the goal of the deployment. However, it does not mean that the analysis of the model have to follow this sequence. For instance, the factor Planning can be saw from the standpoint of who is auditing the process as a whole and perceives the need of changing the planning of the deployment. In this case, the origin of the analysis is not planning, but auditing.

The policy factor. The Policy must detail the rules for several other factors, starting with the Training, accompanied with an entire specification for the course that will enable the teachers to use the tablet. The Policy also must rule the teacher engagement, specifying not only what the responsibilities of the teacher are as a recipient of the device grant, but also what the expected outcomes are from the use of tablet computer in the classroom. It involves benchmarks for the Maintenance factor, including deadlines for fixing and/or replacing the broken devices. The factor Hardware regards the device itself, which must have a technical specification compatible with the teaching practice.

Although the technical and pedagogical support involves human resources managed by the local administration, the Policy must specify what kind of support the teachers can expect in their use of the tablet computer. The infrastructure must be specified in details; not only considering the peripherals, but also other variables needed to make tablet based teaching appropriate. Finally, the Content factor must be included in the set of deployment policies. There must be at least the specification of what the content must minimally present regarding structure

and format. More details on what must be specified for each factor will subsequently be mentioned in their respective descriptions.

The hardware factor. Having an appropriate hardware is essential for teacher engagement because it enables him/her to do what is supposed to be done, i.e. to use the tablet computer for teaching in the classroom.

The Hardware factor represents the tablet computer, the device whose introduction in the teaching process generated the deployment studied in this research. The basic hardware policy addresses the type of usage that the teachers must respect with the use of the tablet computers, but the planning must be comprehensive for this aspect of the deployment.

The device's technical specification must be compatible with the pedagogical strategies designed superficially in the planning and detailed by the teachers and pedagogues involved in the pilot project. It also must address indirect variables that are important for the day-by-day device usage, such as long battery life and long-range antennas for getting connectivity with weak Wi-Fi signals. Even so, if the planner cannot guarantee that there is an effective infrastructure standard for all the schools involved in the deployment, the technical specification must be flexible to attend the variety of school realities. For instance, if Wi-Fi signal will not be available in the classroom, the hardware must be offered with a larger memory to allow the teacher to store all of the needed content on the device. The device performance must be good enough to support the most damaging apps for the hardware specified in the pilot project.

The policies for hardware must specify the logistics involved in the device delivery to fit in the school calendar. There must be time enough to perform the procedures related to other factors, such as training, infrastructure setup, and methodology planning. A specification of a minimum quality standard for the devices must be mandatory in the hardware policies, especially

when the device purchase is based on a bidding process. Attending to the technical specifications for the hardware is not enough to guarantee that the devices will have the suitable quality to bear everything throughout its expected lifespan. Consequently, it is also important to have a percentage limit for the devices that present some hardware problem not related to device misuse. Any defect rate higher than that specified in the purchase contract must imply a punishment for the hardware provider.

The maintenance factor. The policy for maintenance must include a time frame for fixing broken devices, with the use of defined logistics for transporting the devices between the school and the maintenance service provider. Even so, spare devices must make up part of the school structure for the cases that the repair takes too long. The maintenance contracts must cover the expected device lifespan, with different levels of support: one for ordinary maintenance to fix the simpler hardware problems, and another for those cases that the maintenance cannot meet the established time frames for support.

The technical support factor. Technical support differs from maintenance because it is not related to fixing hardware problems, but only getting involved with software issues, such as installation, setup, and usage support. It is important for the teachers to have staff that they can count on to solve any operational problems or to answer questions regarding device usage. Also, the technical support team must be prepared to help the teachers to deal with the infrastructure elements, such as connectivity and peripherals.

Technical support must also manage the Internet access control if any. This means that there must be people monitoring how the school network is being used. It must prevent connectivity usage abuse, enhance the security policy, and anticipate some improvement or setup needed for attending some tendencies in the use of the infrastructure. Preferably the technical

supporters must take part as full-time permanent staff, not part time contractors. Having a satisfactory technical support is not essential for teacher engagement, but it is very stimulating when there is somebody to address all of his or her questions and concerns regarding the operational use of the tablet computer.

The Infrastructure factor. Ideally, the Wi-Fi signal must cover the entire school facility, including external areas. In the cases that the policy involves the use of mobile devices by both teachers and students, there must be a Wi-Fi network for students separated from the Wi-Fi network used by teachers and administrative staff. Not only because of security matters, but also to guarantee the quality of the Internet connection speed for the teachers. When planning the deployment, the policymakers need to include the peripherals and computers needed to come along with the tablet computers, both must be according to the specification obtained from the pilot project. In fact, if the pilot project is properly designed, it will provide information on the actual demand for equipment to support the use of tablet computers in the classroom, regardless of the reality, size, or geographical distribution of the school's district. If online content hosting is included in the project, the infrastructure must be designed to support the huge demand for remote access that teachers all over the country might create to use the content. It is important to notice that just the mobile device is not enough regarding equipment even to make a simple presentation for a class. It means that the infrastructure enables teacher engagement since it is essential for the pedagogical use of the tablet computer.

The curriculum factor. The planning must specify the curriculum in a way that is suitable for the context of using the tablet computer. It is important to notice that the inclusion of tablet computers as a pedagogical tool has a high impact on the requirements for curricula and methodologies. The curriculum gives the directions for the pedagogical support of the teacher

and develops methodologies according to its directions. It is recommended that a new curriculum be designed considering the paradigm of the use of tablet computers in the classroom.

The content factor. The content implies following the policies for developing and/or using third parties' online educational resources, occasionally hosted by the infrastructure provided by the mobile device deployer. The availability of ready-to-use content is a factor that boosts the teacher engagement. At the same time, the Content factor is also benefited when teacher engagement results in a content production that is released for distribution. Either way, the content improves the pedagogical support aspect.

As long as the deployer has the control over the content to be distributed to teachers, it is important that it follow a standard established by the Policy factor. If the educational resources follow a standard, it is easier for the teacher to use them. Since the teachers learn how to find the resource, how to use it, and how to modify or adapt it to their teaching context, the use of the content has more productivity and effectiveness.

The pedagogical support factor. During the deployment phase, it is common that the teachers are not experienced enough to have the autonomy to develop their own teaching methodologies to use the tablet computer in the classroom, even after training successfully to learn them. A pedagogical support team is necessary to fill gaps left by the training regarding know-how about the pedagogical aspects of dealing with the new teaching paradigm. Having the staff to provide pedagogical support is a factor that collaborates with the teacher engagement factor, especially for those that have little digital inclusion and critical thinking about the pedagogical possibilities of the use of mobile devices.

The methodology factor. Since the school districts have to deal with a great variety of teacher profiles regarding digital inclusion, the pedagogical support can guarantee

standardization in the process of getting the curriculum directions and producing the adequate methodologies to support the teachers' demands for their lessons based on the use of mobile devices. The content might come along with its methodology of use, but it does not mean that the school must stick with it, especially if it is the case of using an external content provider. Therefore, it is important that the school districts develop their own methodology. Notice that the methodology must include very specific aspects of the teaching method, such as the way of presenting the lesson, the strategy for exercising the topic, and how to assess the learning outcomes. The use of tablet computers might change all these aspects, improving the effectiveness of some,

The dissemination factor. Dissemination of the new teaching paradigm that is being deployed stimulates mainly the leadership and the teacher engagement, besides the students, school staff, and all kinds of stakeholders. It helps to communicate all the planning details and policies involved in the deployment. The dissemination must be supported by a structured communication, counting on resources such as a newsletter, website, online demonstration videos, and lectures. Ideally, it must start before the tablet computer distribution happens, in order to make the stakeholders aware of what is going to happen to the teaching practice and the expected outcomes.

The leadership factor. There are two types of leadership to be considered: formal and informal leaders. The formal leaders are those supported by official roles in the hierarchy of the school district. The informal leaders are those that stand out among the teachers because of their engagement, which is differentiated by their attitude, such as supporting their colleagues, creating content, or developing methodologies. Notice that when the leadership counts on digital inclusion and training, it boosts teacher engagement as long the leaders act towards helping their

colleagues and subordinates to overcome difficulties and to enhance their performance in the deployment. Hence, it is important that the formal leaders (supervisors, coordinators, principals, and the like) take part in the training to understand the technical and pedagogical process of the use of tablet computers in the classrooms. Also, the informal leadership must have support from the school to develop any activity that collaborates with the deployment, such as giving technical or pedagogical support to colleagues, creating content to be used by other teachers, or developing methodologies to be followed in the classes.

The digital inclusion factor. Digital inclusion is a factor that is improved by the teacher engagement with the deployment, although it is an incorporation of knowledge on information technology that might be the result of experiences outside of the teacher's school context. As long as the teacher puts into practice the use of the tablet computer to prepare and present lessons, it results in an increment of the teacher's digital inclusion, regardless of whether what has been done was learned in a deployment-related course or another context. The resulting digital inclusion causes a sensation of confidence in the use of the technological resources that feeds teacher engagement and stimulates leadership engagement.

The training factor. The training must strictly follow a well-defined policy of standardization of the knowledge to be learned by teachers of different schools and groups. It also allows the creation of a set of outcomes to be expected from the teachers as a result of their engagement with the project. In fact, the training enables the teacher engagement and helps formal and informal leaders to engage in the project as well.

The training must involve the technical and pedagogical skills that consider the school reality and is supported by content specifically developed for the deployment context. The lower the digital inclusion of the teachers involved in the training, the more it must be based on a face-

to-face format. If the content policy allows the use of educational resources other than those managed by the school district, the training must enable the teacher to deal with copyright issues. It is important for the teacher to know how to use, copy, and modify third-party content.

The teacher engagement factor. The teacher engagement is influenced by most of the other factors since it is the expected result of the deployment, but it does not mean that teacher engagement is not a factor to be considered in the model. The teacher engagement is a factor by itself because it relates some actions/status that can influence the success of the deployment as a whole, regardless the situation of the other factors. It does not matter if the deployment offers all other factors but the teachers refuse to engage the project. The verbs used in the model give a clue about the importance of each factor for teacher engagement. The most important factors are those whose verb, that defines the relation to teacher engagement, is "enables." This happens because they are the most necessary factors for the deployment: hardware, infrastructure, and training. Other factors can "boost" the teacher engagement, such as digital inclusion, leadership, and ready-to-use content.

Furthermore, teacher engagement is a linking factor for others. For instance, only effective teacher engagement can make the training turn into digital inclusion. Another example is the infrastructure that enables the effectiveness of the hardware usage only if teacher engagement is realized. The same can be said about the content production; it only happens if the teacher engagement avails the school's infrastructure to produce content. Still, only teacher engagement can produce excellent training results in content production and methodology development. It demonstrates that, although Figure 18 highlights the Hardware factor as being the center of the model, the mobile device means nothing without teacher engagement in its use.

The auditing factor. It is important that there be clear plans for the recipient teachers of the mobile devices, not only regarding bureaucracy and liability, as perceived in the Brazilian deployment, but also on what is expected of the teacher on the use of the granted technology. There must be benchmarks to be reached, defined by the teacher engagement policy. Hence, tools and methods planned for auditing whether or not these benchmarks have been reached, as well as what kind of outcome has been obtained from the teacher engagement. The planning factor needs the feedback of the auditing result to optimize its directives based on the outcomes reached by deployment process. The auditing rules, defined in the plan, must be clearly disseminated to the leaders and teachers, to allow them to know in advance about what result is expected of them regarding deployment outcomes.

Model Generalization and Its Application in Other Contexts

The LSMDD model was designed in a way to avoid the particularities related to the scale of the Brazilian deployment as well as the hierarchical structure of its administration. As presented in Figure 17, the Brazilian deployment has different levels of institutional management: Federal Government, State Government, regional branches of the State Secretary for Education, and schools. However, the model avoided being allusive to these administration instances in order to become generic and, then, to be feasible when applied in other contexts other than the Brazilian one.

Thus, the level of abstraction of the LSMDD model can be used in a small district with some thousands of tablet computers to be deployed, with just a regional or municipal level of administration. However, at the same time, the model still can be applied on a nationwide scale like the Brazilian case. Only the interpretation of what each instance of the model represents in

the real world must be changed in the model reading, according to the scale of the context in which the LSMDD model is applied.

Chapter 6 Conclusion

This chapter presented the LSMDD model resulting from this study. Also, it described each factor considered important by the research participants regarding the large-scale deployment of tablet computers in a school district, regardless the context of the deployment. The end of the chapter presented the argument which sustains that the model can be generalized and applied in another context other than the Brazilian one.

The next and final chapter presents the final considerations about this research, with the conclusions that this study led the researcher to reach, the comments on what was perceived in the Brazilian deployment during this research, the limitations of this study, and some recommendations for further studies on the dissertation topic.

Chapter 7

CONCLUSIONS

This last chapter wraps up the dissertation. It begins with a description of the impressions the researcher had about the Brazilian deployment. Afterwards, the section Research Outcomes summarizes what was accomplished regarding research and academic results with this study. Then, the potential limitations of the research are presented in the section Limitations of the Research Study. Finally, the section, Recommendations, provides suggestions for further studies on the subject of this research.

The Brazilian Deployment

First, the objectives of this research do not include assessing or judging the Brazilian large-scale deployment of tablet computers in public schools. The qualitative approach of this study does not allow an assertive conclusion about the extent of the success or failure of this deployment. However, as a Brazilian citizen, the researcher cannot avoid presenting some impressions from what was observed during the visits done in schools located in different states across the country, as well as from the interviews performed during the research data collection phase.

The lack of information about the Brazilian deployment planning prevents any researcher to defend the way in which it took place across the country. What is left for the researcher to evaluate about the deployment is just observing its procedures and outcomes. There is no way to distinguish whether it was the result of bad planning, a lack of planning or the result of an inefficient execution of the plans. In fact, according to Honorato (2012), because of undisclosed

reasons, the information about some projects of the Ministry of Education, were not released to the general public.

All the uncovered information on the deployment pilot projects was related to initiatives performed by the state government, not the federal government, from which this project was launched. Even so, all the documentation found on the Internet about pilot projects indicates that they were performed after the announcement of the tablet computer project. In fact, they had already started with the distribution of the tablet computers that had been acquired through a big public bidding. This meant that if one of the pilot projects had identified some problems in the technical specification of the hardware, for instance, it would have happened after the purchase had already been made. These pilot projects, then, did not work for the federal government planning at all. They worked just for the state governments who had to adjust their methodology to implement the devices they had already received from the federal government.

This situation is a contradiction which is defended by Bassi (2010), who identified mandatory elements that must be present in a large-scale deployment, shown in Chapter 2. Among these factors, there is “project management”, which relates directly to the Planning factor for a pilot project based approach. Even considering the limited information about the pilot projects found on the Internet, it is clear that they were performed in schools located in the state capitals or metropolitan areas. It is not recommended by Bassi (2010), who states that the pilot projects must consider realistic scenarios for the deployment, which includes schools located in remote cities.

The Federal Government policymakers should have implemented the pilot project, before making the million-dollar purchase of tablet devices. However, the iPads were launched in 2010 (Apple, 2010) and the Honeycomb, the Android for tablet computers, was launched only in 2011

(Verge, 2011). It was less than one year before the Ministry of Education announced the project. Hence, there wasn't enough time for a serious pilot project, which should take at least a couple of years since the school term takes one year for any grade in Brazil.

A complex deployment, involving many different factors to be considered, with different administration instances, in a large country, on so large a scale, and in a relatively short time frame deserves careful planning, including pilot projects. Otherwise, the observed outcomes reinforce the opinion of Cardoso (2012), in which she states that this "education tablet project" is another politician technophile.

The problems to be managed in schools with different infrastructures seem to differ a lot. In schools with poor infrastructure, the main problems were the lack of Internet connection throughout the school area, absence of electrical outlets in the classrooms, and insufficient peripherals, such as projectors, televisions, and interactive smart boards. On the other hand, the schools with good infrastructure faced different problems, such as non-supportive principals, lack of pedagogical planning and support, and absence of policy for the use of the devices, and the related technology, such as Internet connection, projectors, and television.

The Minister of Education declared in person that there would be an expansion of the Internet connectivity in all involved schools to support the use of tablet computers (Mercadante, 2012; Honorato, 2012; G1a, 2012). However, it was not what the researcher witnessed in the majority of the visited schools. This important infrastructure detail was one of the most frequent complaints found in the online survey responses. In fact, "Internet Connectivity" would have been one of the most coded factors if it had not been combined in the "Infrastructure" category.

The peripherals announced by the minister Aloísio Mercadante as part of the project was found in visited schools in the same proportion announced (Mercadante, 2012). However, the

proportion of 1 projector for each set of 10 tablet computers was insufficient for schools that had a high teacher engagement with the project. Once more, the lack of an adequate pilot project is detrimental to the planning factor.

The 360 hours of training announced by the Federal Government (Honorato, 2012) turned out to be fiction in some schools. This researcher visited several schools inland of a state whose teachers stated that they only had a couple of hours of training. According to the respondents, it was just enough to learn how to turn on, unlock, and to do the basic setup of the device. On the other hand, there were states that provided the 360 hours of training but mostly accomplished remotely. Depending on the level of digital inclusion of the teacher, on-site training is important for mastering the use of the device. This kind of issue could have been detected and fixed if there would have been an auditing process for monitoring the deployment outcomes, as included in the LSMDD model.

As there was no previously structured curriculum and methodology to give productivity to the introduction of the tablet computers in the classroom during the deployment, the training in some states was mostly focused on the technical aspect of the device. Several other studies confirm the negative perception narrated by the research participants on the Training factor (Neves & Cardoso, 2013; Brito, 2013; Oliveira, 2014; Nascimento, 2014; Araújo & Ribeiro, 2014; Lucas, 2014; Souza, 2014).

In fact, when questioned about the pedagogical planning needed to introduce the tablet computers in educational processes, the Minister of Education either avoided responding to the question directly or demonstrated that he did not have a clear understanding of the meaning of pedagogical planning. His answers were vague and mostly focused on the technology and on the possibilities that the tablet computers would bring to the teacher's routine. He demonstrated some

intimacy with the classroom environment because he is a former university professor, with a doctoral degree in Economics from one of the best Brazilian universities. However, his speech seemed to disregard the poor infrastructure found in a significant amount of basic-education schools across the country.

More than simply providing the knowledge on the use of tablet computers in the classroom, the training, along with digital inclusion, results in teacher engagement allowing the development of a culture of tablet computer usage for educational purposes. This culture must continue using the hardware; otherwise, the chances of teacher engagement are sharply reduced. However, the fact that the initial planning did not include training for the teachers (Maia & Barreto, 2012, p. 51), along with the absence of a pedagogical approach in the public discussions on the tablet computer project (Costa & Machado, 2012) were signals that the policymakers had a strong focus on technology in their planning, rather than pedagogical and operational details.

In terms of content, the Brazilian teachers did not have the same variety of content available as teachers from countries that have English as the native language. The Portal do Professor (Teacher's Portal) seemed to have an impressive amount of OER. However, it was not easy to find the right OER to meet the teachers' requirements, which is a problem faced by the users of any large OER repository (Shaffhauser, 2015).

When considering any material found on the Internet, the content in Portuguese is much more limited than the content in English. Reliable estimates indicate that only 2.6% of the content on the Internet is available in Portuguese, whereas the content in English makes up 53.7% of the online content (W3Techs, 2016). This research did not find stats that indicated the amount of OER for each language, but considering the ordinary content, it is possible to have an

idea that it is more difficult for a Brazilian teacher than for a teacher in an English speaking country to find the content that meets his/her requirements.

In fact, the policymakers seemed to think they would have the teacher engagement and success of the same magnitude as the numbers involved in the project. They thought they just needed to provide the hardware and improve the infrastructure a little bit and the rest would come naturally. According to the data collected during this research, their desired outcomes were not achieved. Unfortunately, if there was some study or information that expressed the level of adherence of teachers to the deployment, it does not seem to have been published. What can be said about the teacher engagement from the collected data is that it was much lower than the expected.

In a couple of the few visited schools that had the highest rate of teacher refusal to use the tablet computers (1 out of 20 teachers engaged in the deployment for each school), the researcher perceived an inadequacy of teacher digital inclusion and attitude towards the tablet computer paradigm. The interviews done with the teachers of these schools caused the researcher to conclude that teaching based on tablet computers is not suitable for all the teachers. Not only because of the lack of digital inclusion or training, but also because of the teacher's resistance to get out of their comfort zone, because of a lack of support from policies and laws that would have empowered them to change their attitude. For teachers that are well protected by the law, which practically prevents the public workers from ever being fired, only incentive policies could make them get out of their comfort zones and embrace the project.

Even in schools that have financial incentives for teachers to improve their teaching methods with the tablet computers, it is remarkable the way that the teachers not involved in the tablet computer deployment comment on those who are involve in the deployment. The teachers

that effectively are involved in the deployment are treated as special professionals, capable of doing "extraordinary" things regarding using technology to enhance their methods. On the other hand, the narrative of these digitally included teachers about "the rest" of the teachers reinforces the delineation of the divide there is between the two groups.

Faced with this situation, the ideas of Hall and Khan (2002) seem to be suitable, with the approach of their model for technology adoption. They propose that the tablet computer should not be distributed without any criteria. The devices should be handed firstly to those teachers that demonstrate enough skills to present positive outcomes in a short time frame and with little training. As long as the positive results are being demonstrated by the practice of this first group, other groups of teachers could be included in the project, with a longer training period, and more support (technical and pedagogical). The public initiative could be optimized with this screening of those teachers that could afford a return on the investment made. Considering all teachers as being able to adhere to the project, even with an excellent training (that does not exist), is not a realistic policy.

In other words, the bottom-up approach works better than the top-down one in a nationwide scale of deployment. Attending to the request of teachers, spread out around the country, that ask for mobile devices to use in their classes, is more interesting than making a centralized device purchase and distribution. Even if this approach implies paying a higher price per unit due to the lower purchase scale, it is better to pay a higher price to provide devices for teachers that demonstrate engagement in advance, than to teachers that are not necessarily prone to adhering to the project.

The lack of a realistic view of the deployment planning is mostly due to the distance between the policymakers and the vast boundaries of the educational system, especially the small

schools located in the inner cities. This is reinforced by the lack of suitable pilot projects which would provide feedback to the policymakers with the information needed to improve the planning at the Federal Government level. This substantial distance between the policymakers and the executors, separated by several levels of hierarchy in administrative, makes this large-scale and complex deployment very inefficient.

It would be important to have professionals in each regional branch of the state secretaries of education, or even at each school, with enough skills and autonomy to define the planning and policies accordingly for each local reality. Reducing the scale of the deployment increases the control over several of the variables involved and, consequently, increases teacher engagement and the likelihood of success.

Research Outcomes

The guiding questions of this research focused on the identification of factors to be considered in a large-scale deployment of tablet computers in public schools in Brazil. What are they? Is there some relationship between them? Is there a feasible model for describing these factors and their relationships? Are there elements or procedures that could be added to the deployment in order to improve the process and/or mitigate problems? In sum, the dissertation answered these questions, by presenting the big picture of the Brazilian deployment. More than answering these questions, this study has unveiled some of the reasons why the Brazilian tablet computer deployment followed a tendency identified around the world in which large-scale deployments have been reaching outcomes far below what was expected.

With regards to the resulting model, the LSMDD is definitely more complex than any other models used for technology deployment or dissemination. However, it is important to understand that the terms “mobile device” and “large scale” are decisive in making some

deployment models obsolete, in a deployment such as the one that is the subject of this study. The reality of dealing with a device that is mobile, light, and can go wherever the user goes (as well as outside of the school facilities), makes a lot of difference regarding some factors studied, such as maintenance, logistics, methodology, and digital inclusion. It is especially differentiated from other kinds of technology deployment when the variable scale is considered.

No other educational technology so far used in our society had the potential scale that the tablet computers have. It is completely different and simpler when the technology is equipment that is used in a fixed position within the school facilities, and on a much smaller scale, such as interactive whiteboards or desktop computers. Despite its complexity, this study has proven that the model emerges from the deployment reality. Therefore, the resulting model can be used in another context other than the Brazilian one, including contexts related to private and small school districts.

Limitations of the Research Study

The studied deployment is a phenomenon that involves large-scale initiatives. There are hundreds of thousands of tablet computers, distributed throughout tens of thousands of schools, involving hundreds of thousands of stakeholders, such as teachers, technicians, principals, managers and policymakers. Thus, the results of this study cannot guarantee that the big picture of the Brazilian tablet computer deployment fits all particular cases across Brazil. As it is a qualitative research, it is possible that other realities other than those described in this dissertation might be found in a non-visited state or city in Brazil. As long as the Brazilian society presents a high contrast regarding social and economic conditions, the reality of the state, city, or even the school may vary quite a bit in relation to the big picture that this study ended up producing about the Brazilian tablet computer deployment.

The resulting model of this research can be replicated in other educational contexts in the real world within the boundaries specified by characteristics of the Brazilian high school districts. These boundaries are the same found in the majority of the western countries, involving similar features, such as hierarchy, operation, and administrative structures. However, some adaptation might be needed to apply the model depending on the features of the country, the society and the educational district under analysis.

Recommendations

The impressions the researcher had about the Brazilian large-scale tablet computer deployment in terms of teacher engagement can be subject to further studies. The use of a quantitative research approach is recommended to complement the qualitative results obtained from this study. The LSMDD model can be used to underpin the research questions, basing them on the logic of the deployment specified in the model design.

The suspicion that the physical distance between the school and the policymakers influences the quality of the school infrastructure, rose during the data analysis, can be subject of a research specifically designed to investigate such phenomenon.

The Research Group Media and Knowledge, from the Federal University of Santa Catarina, of which the researcher is a part of, will keep this study running for the next few years, using the same methodology and similar methods. The continuation of this study can confirm the validity of the LSMDD model. However, as long as it will systematically observe the same variables, the most important finding to pursue is whether or not the Brazilian deployment model will develop a culture of usage of tablet computers in the teaching practices in Brazilian public schools.

REFERENCES

Allan, G. (2003). A critique of using grounded theory as a research method. Electronic Journal of Business Research Methods, 2(1), 1-10.

Amorim, R. (2012, July 12). A revolução por trás do apagão de mão de obra [The revolution behind the labor shortage]. *Isto é Magazine*. Retrieved from http://www.istoe.com.br/colunas-e-blogs/coluna/239414_A+REVOLUCAO+POR+TRAS+DO+APAGAO+DE+MAO+DE+OBRA+"

Anderson, C. (2008, August 8).The end of theory: The data deluge makes the scientific method obsolete. *Wired.* Retrieved from http://www.wired.com/2008/06/pb-theory/

Apple. (2010, January). Apple launches iPad. Retrieved from http://www.apple.com/pr/library/2010/01/27Apple-Launches-iPad.html

Araújo, S,. & Ribeiro, A. (2014). As dificuldades encontradas pelos docentes no processo de ensino, a partir do uso dos recursos tecnológicos disponíveis na rede estadual de ensino da Bahia [The difficulties faced by the teachers in the teaching process, with the use of techological resources in the school state system of Bahia]. *Revista de Educação do Vale oo São Francisco*, 4(6), 232-252

Atlas.ti (n.d.). Software for qualitative data analysis, management, and model building. Retrieved from http://atlasti.com/wp-

content/uploads/2014/07/atlas.ti6_brochure_2009_en_01.pdf?q=/fileadmin/atlasti/downloads/atlas.ti6_brochure_2009_en.pdf

Bainbridge, S. (2013, November 6). *Development and evaluation of a pedagogical model for an open university in Nepal, based on geographical, regional, and linguistic factors*. Doctoral Dissertation. Retrieved from https://www.researchgate.net/publication/267867641_Development_and_Evaluation_of_a_Pedagogical_Model_for_an_Open_University_in_Nepal_Based_on_Geographical_Regional_and_Linguistic_Factors

Banco Nacional de Desenvolvimento Econômico e Social. (2011, November 25). Indústria de base [Base industry] Retrieved from http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Hotsites/Relatorio_Anual_2011/Capitulos/desempenho_operacional/insumos_basicos/

Bassi, R. (2010, September). Practical guide to pilot projects and large scale deployment of ICTs in the education sector. Retrieved from http://www.researchictafrica.net/policy/universal_access_and_service/International-GESCI_Pilot_Projects_Education.pdf.

Berent, N. & Seidel, S. (2014). Towards computational grounded theory? Twentieth Americas Conference on Information Systems. *Twentieth Americas Conference on Information Systems* (pp. 1-11)

Bocconi, S., Kampylis, P., & Punie, Y. (2013). Framing ICT-enabled Innovation for Learning: The case of one-to-one learning initiatives in Europe. *European Journal of Education*, 48(1), 113–130. doi:10.1111/ejed.12021

Bogart, W. G. Van De. (2012). Developing multi-literacy skills in e-learning environments using tablet computers at the primary grade level in Thailand. *International e-Learning Conference* (pp. 64–72).

Bom Dia Brasil (2013, October 29). Défict de mão de obra no Brasil [Defict of labor in Brazil]. *Infoescola Magazine*. Retrieved from http://g1.globo.com/bom-dia-brasil/noticia/2013/10/pesquisa-revela-que-falta-de-mao-de-obra-qualificada-prejudica-empresas.html

Bort, J. (2013, June 2). The History Of The Tablet, An Idea Steve Jobs Stole And Turned Into A Game-Changer. *Business Insider*. Retrieved from http://www.businessinsider.com/history-of-the-tablet-2013-5?op=1

Brazilian Federal Constitution § 211, Section I, Chapter III (1988).

Brigatto, G. (2015, April 6). Vendas de smartphones crescerá em ritmo mais lento em 2015 [Smartphone sales will grpw at a slower pace in 2015]. *Valor Econômico*. Retrieved from: http://www.valor.com.br/empresas/3993714/venda-de-smartphones-crescera-em-ritmo-mais-lento-em-2015-preve-idc

Brito, G. (2013, January 13). Tablet para os professores: eu quero! [Tablet computers for teachers: I want it!]. *Gazeta do Povo*. http://www.gazetadopovo.com.br/blogs/educacao-e-midia/tablet-para-os-professores-eu-quero/

Bruini, E. (n.d.). Educação no Brasil [Education in Brazil]. *Brasil Escola*. Retrieved from http://www.brasilescola.com/educacao/educacao-no-brasil.htm

Bulco, R. (2012, August). Tablets: A sala de aula vai mudar? [Tablets: Is the classroom going to change?]. *Revista A Rede.* Retrieved from http://www.revista.arede.inf.br/site/edicao-n-83-agosto-2012/4400-na-escola-tablets-a-sala-de-aula-vai-mudar

Bump, P. (2014, March 25). Here is when each generation begins and ends, according to facts. *The Atlantic.* Retrieved from http://www.theatlantic.com/national/archive/2014/03/here-is-when-each-generation-begins-and-ends-according-to-facts/359589/

Burden, K., Hopkins, P., Male, T., Martin, S., & Trala, C. (2012, October). iPad Scotland Evaluation. Retrieved from http://www.janhylen.se/wp-content/uploads/2013/01/Skottland.pdf

Burnier, J. & Gonçalves, M. (2012, August 13). Dificuldade de encontrar mão de obra qualificada afeta economia brasileira [Difficulty in finding qualified labor undermines the Brazilian economy]. *Jornal Nacional.* Retrieved from http://g1.globo.com/jornal-nacional/noticia/2012/08/dificuldade-de-encontrar-mao-de-obra-qualificada-afeta-economia-brasileira.html

Cardoso, C. (2012, July 10). Tablets na sala de aula : mais do mesmo [Tablet in the classroom: More of the same]. *Carta Capital.* Retrieved from http://www.cartacapital.com.br/educacao/tablets-na-sabela-de-aula-mais-do-mesmo

Castellano, S. (1996). *Proposição de um modelo para planejamento e desenvolvimento de projetos em empresas de alta tecnologia* [Proposal of a model for high-technology companiy planning and development]. (Master thesis). Retrieved from IBITC (http://bdtd.ibict.br/vufind)

Caswell, T., Henson, S., Jensen, M., & Wiley, D. (2008). Open Educational Resources : Enabling universal education. *The International Review of Research in Open and Distance Learning*, 9(1), 1–11.

Central Intelligence Agency (CIA). (2015). The world factbook: Brazil. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/br.html

Clarke, B., & Svanaes, S. (2012, December 4). One-to-one tablets in secondary schools : An evaluation study. Retrieved from http://www.e-learningfoundation.com/Websites/elearningfoundation/images/PDF%20Documents/Honeywood_2012_Barbie_Clark.pdf

CNN Money. (2015, January 6). World's largest economies. *CNN Money.* Retrieved from http://money.cnn.com/news/economy/world_economies_gdp/

Cohen, M., Kahn, D., and Steeves, R. (2000). *Hermeneutic phenomenological research: A practical guide for nurse researchers*. Thousand Oaks: Sage Publications.

Collin, S., Karsenti, T., & Dumouchel, G. (2011). L'interaction en ligne pour développer la pensée réflexive des futurs enseignants: Patterns réflexifs et influence de l'outil. In Editors: Baron, G., Bruillard, E., & Komis, V. (ed.) *Sciences et technologies de l'information et de la communication en milieu éducatif: Analyse de pratiques et enjeux didactiques* (pp.197-204). Greece. Athenes: New Technologies Editions. ISBN: 978-960-6759-75-8

Convergência Digital. (2012, August 20). Estácio distribui 14,5 mil tablets e nacionaliza projeto [Estácio distributes 14.5 thousand tablet computers and nationalizes the project]. *Convergência Digital.* Retrieved from http://convergenciadigital.uol.com.br/cgi/cgilua.exe/sys/start.htm?infoid=31530&sid=14

Conselho Nacional de Educação. (2006). Resolução CNE/CP 1/2006 [Resolution of the National Council of Education, number 1 of 2006]. Retrieved from http://portal.mec.gov.br/cne/arquivos/pdf/rcp01_06.pdf

Cooney, A. (2010). Choosing Between Glaser and Strauss – An Example. *Nurse Researcher*, 17, (4), 18-28.

Cooney, A. (2010). Rigor and Grounded Theory. *Nurse Researcher*, 14, 4, 17-22.

Corbin, J. & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Third Edition. Thousand Oaks, CA: Sage Publications.

Costa, B. & Machado, R. (2012, February 2). Sem saber como usar [Without knowing how to use]. *Revista Ponto Com.* Retrieved from http://revistapontocom.org.br/materias/mec-quer-tablets-sem-saber-como-usar

Costa, G. (2013). O ensino médio no Brasil: Desafios à matrícula e ao trabalho docente [High school in Brazil: Chalenges for the registration and for the teaching work]. *Revista Brasileira de Estudos Pedagógicos*, 94(236), 185-210.

Costa, M. (2011, August 9). Computadores chegam às escolas públicas, mas não à sala de aula [Computers come to public schools, but not to the classroom]. *Last second*. Retrieved from http://ultimosegundo.ig.com.br/educacao/computadores+chegam+as+escolas+publicas+mas+nao+a+sala+de+aula/n1597126901899.html

Diário do Commercio. (2015, December 24). Banco Central prevê queda de 3,6% do PIB de 2015. [Central Bank predicts a decrease of 3.6% of GDP]. *Diário do Commercio.* Retrieved from http://www.diariodocomercio.com.br/noticia.php?tit=banco_central_preve_queda_de_3,6_do_pib_em_2015&id=164334.

Dixon-Woods, M., Bonas, S., Booth, A., Jones, D., Miller, T., Sutton, A., Shaw, R., Smith, J., & Young, B. (2006). How can systematic reviews incorporate qualitative research? A critical perspective. *Qualitative Research* 6(1), 27–44.

Dixon, B., & Tierney, S. (2013). Bring your own device to school. Retrieved from http://www.digipubs.vic.edu.au/pubs/microsoft-in-the-classroom/docs/BYOD%20Discussion%20Paper%20A4.pdf

Donaldson, R. L. (2011). *Student acceptance of mobile learning* (Doctoral dissertation). Retrieved from DigiNole (http://diginole.lib.fsu.edu/)

Donovan, L., & Strudler, N. (2007). Teacher concerns during initital implementation of a one to one laptop Inititative at the middle school level. *Journal Research on Technology in Education,* 39(3), 263–286.

Dündar, H., & Akçayır, M. (2014) Implementing tablet PCs in schools: Students' attitudes and opinions. *Computers and Human Behaviour,* 32, 40-46.

Eakin, J. M., & and Mykhalovskiy, E. (2003). Reframing the evaluation of qualitative health research: reflections on a review of appraisal guidelines in the health sciences. *Journal of Evaluation in Clinical Practice*, 9(2), 187-194.

Educarede (2011, October 3). Desafios da Mobilidade: Uso de laptops, tablets e celulares na educação [Mobility chalenges: The use of laptops, tablets and cell phones in education]. Retrieved from https://www.youtube.com/watch?v=MOdg6uHJ3hk

Estadão (2011, April 11). Falta capital humano [There is a lack of human capital]. Retrieved from http://opiniao.estadao.com.br/noticias/geral,falta-capital-humano-imp-,704598

Faas, R. (2013, February 7). A supermassive iPad deployment in Turkish schools could be a model for business. Retrieved from. http://ryanfaas.com/index.php/2013/02/07/a-supermassive-ipad-deployment-in-turkish-schools-could-be-a-model-for-business/

Daily Sabah. (2014, July 2). Fatih Project distributes 732,000 tablets. Retrieved from http://www.dailysabah.com/education/2014/07/02/fatih-project-distributes-732000-tablets

Fernandes, E,. & Maia, A. (2001). Grounded Theory: Métodos e técnicas de avaliação [Grounded Theory: Methods and techniques for assessement]. Retrieved from: http://repositorium.sdum.uminho.pt/handle/1822/4209

Ferreira, D. (2013, October 14). Inclusão digital na escola e a falta de estrutura [Digital inclusion at school and the lack of structure][Web log comment]. Retrieved from http://www.prof-edigleyalexandre.com/2013/10/inclusao-digital-na-escola-e-a-falta-de-estrutura.html

França, T,. & Gonçalves, F. (2010). Provisão pública e privada de educação fundamental: diferenças de qualidade medidas por meio de propensity score [Public and private provision for basic education: quality differences measured by the propensity score]. *Economia Aplicada*, 14(4).

Frank, B. (2013, July 26). LA schools plan to give free iPads to 640,000 students by 2014. *GeekWire*. Retrieved from http://www.geekwire.com/2013/la-schools-plan-give-free-ipads-640-thousand-students-2014/

Fullan, M. (2001). *The new meaning of educational change (3 rd ed.).* New York, NY: Teachers College Press.

G1. (2012a, February 3). MEC vai comprar 600 mil tablets para escolas públicas de ensino médio [MEC will buy 600 thousand tablete computers for public high schools. *G1 Magazine.* Retrieved from http://g1.globo.com/educacao/noticia/2012/02/mec-vai-comprar-600-mil-tablets-para-escolas-publicas-de-ensino-medio.html

G1. (2012b, August 14). País supera metas do Ideb no ensino fundamental e iguala no médio [The country gets over the Ideb goals in the fundamental education and reaches in the high-school education]. *G1 Magazine.* Retrieved from http://g1.globo.com/educacao/noticia/2012/08/pais-supera-metas-do-ideb-no-ensino-fundamental-e-iguala-no-ensino-medio.html

G1. (2015, July 23). O Brasil tem 13 milhões de analfabetos [Brazil has 13 million illiterates]. *G1 Magazine*. Retrieved from http://g1.globo.com/profissao-reporter/noticia/2015/07/brasil-tem-13-milhoes-de-analfabetos.html

Garun, N. (2012, May 14). Thailand signs the world's largest educational tablet distribution deal. *Digital Trends.* Retrieved from http://www.digitaltrends.com/international/thailand-signs-the-worlds-largest-educational-tablet-distribution-deal/

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory*. Hawthorne, NY: Aldine de Gruyter.

Godoy, A. S. (1998). *Pesquisa qualitativa: Tipos fundamentais*. [Qualitative research: fundamental types] *Revista de Administração de Empresas*. São Paulo, v. 35. n.3. pp. 20 – 29.

Gomes, C. (2012).A qualificação resignada. A má formação da força de trabalho como um problema estrutural do desenvolvimento brasileiro [The resignated qualification. The poor training of the workforce as a structural problem of the Brazilian development]. Master thesis. Retrieved from UNICAMP.

Greenberg, A. (2012, March). Blended learning technology: Navigating the challenges of large-scale adoption. Retrieved from http://echo360.com/sites/default/files/Adoption%20White%20Paper.pdf

Grinter, B. (2010, September 9). Inter-Rater Reiability. Retrieved from https://beki70.wordpress.com/2010/09/09/inter-rater-reliability-apply-with-care/

Hall, B. and Khan B. (2002). *New economy handbook*. In Jones, Derek C.(ed.). Waltham: Academic Press. DOI: 10.3386/w9730

Handal, B., Ritter, R., & Marcovitz, D. (2013). Implementing Large Scale Mobile Learning School Programs : To BYOD or not to BYOD. *World Conference on Educational Media and Technology,* (1), 796–801.

Hazarika, P. (2012, May 16). Thailand signs world's largest educational tablet deal. *Notebook Check.* Retrieved from http://www.notebookcheck.net/Thailand-signs-world-s-largest-educational-tablet-deal.74875.0.html

Hoey, B. (2013, November 2). What is Ethonography. Retrieved from http://www.brianhoey.com/General%20Site/general_defn-ethnography.htm

Honorato, R. (2012, February 12). "Vamos começar pelo professor", diz Mercadante sobre projeto de R$ 180 mi que levará trablets a escolas públicas ["Let's start by the teachers" says Mercadante about the R$ 180 million project that will bring tablet computers to public schools]. Retrieved from http://veja.abril.com.br/noticia/educacao/vamos-comecar-pelo-

professor-diz-mercadante-sobre-projeto-de-r-180-milhoes-que-levara-tablets-a-escolas-publicas

Huimin, M., & Hernandez, J. A. (2011). Price Skimming on a Successful Marketing Strategy : Study of Ipad Launching as Apple ' s Innovative Product. *Proceedings of the 8th International Conference on Innovation & Management*, 389–393.

IBGEa. (n.d.). Contas Regionais do Brasil [Regional Data from Brazil]. *Brazilian Institute of Geography and Statistics.* Retrieved from http://www.ibge.gov.br/home/estatistica/economia/contasregionais/2012/default_ods_2002_2012.shtm

IBGEb. (n.d.). Estatísticas estaduais [State statistics]. *Brazilian Institute of Geography and Statistics.* Retrieved from http://www.ibge.gov.br/estadosat/

IBGE (2010). Senso Demográfico 2010 [Demographic Census 2010]. *Brazilian Institute of Geography and Statistics*. Retrieved from http://www.ibge.gov.br/home/presidencia/noticias/imprensa/ppts/0000000237.pdf

IDGnow. (2014, August 6). Cinquenta e três por cento das crianças e adolescentes internautas no Brasil usam celulares [Fifty-three percent of the children and adolescents in Brazil use cell phones]. *IDGnow.* Retrieved from http://idgnow.com.br/internet/2014/08/06/53-das-criancas-e-adolescentes-brasileiros-usam-celulares/

Imparcial. (2013, November 6). Professores da rede estadual realizam capacitação sobre como utilizar os tablets [State education board teachers do training on how to use the tablet

computers]. Retrieved from http://www.oimparcial.com.br/app/noticia/urbano/2013/11/09/interna_urbano,145803/professores-da-rede-estadual-realizam-capacitacao-sobre-como-utilizar-os-tablets.shtml

INEP (2015). Censo escolar [School census]. *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira Censo Escolar.* Retrieved from http://portal.inep.gov.br/basica-censo

Kafle, N. (2011). Hermeneutic phenomenological research methodsimplified. *Bodyi: An Interdisciplinary Journal*, 5, 2011. ISSN: 2091-0479.

Kastrenakes, J. (2014, August 26). Los Angeles schools halt plan to give an iPad to every student. *The Verge*. Retrieved from http://www.theverge.com/2014/8/26/6069121/los-angeles-schools-halt-plan-ipad-rollout.

Knoema, (2014). Robbery at the national level, rate per 100,000 population. Retrieved from http://knoema.com/atlas/ranks/Robbery

Kotrlik, J. and Redmann, D. (2009). Technology adoption for use in instruction by secondary technology education teachers. *Journal of Technology Education*, *21*(1), 44-59.

Lazzareschi, N. (2010). O apagão de mão de obra no Brasil [The shortage of labor in Brazil]. *Ponto e Vírgula*, 7, 192-199. Retrieved from

Lemos, I. (2012, October 16). Comissão do Senado aprova número limite de alunos na sala de aula [Senate commition aproves a limit number of students for classrooms]. *G1 Magazine*.

Retrieved from: http://g1.globo.com/educacao/noticia/2012/10/comissao-do-senado-aprova-numero-limite-de-alunos-na-sala-de-aula.html

Li, X., Yuen A., & Zou W. (2015). Understanding the Obstacles of Using Tablet as a Learning Tool in Primary Schools from Teachers' Perceptions. In Xiaolei Li, X., Allan, Y. and Zou, W.*, New Media, Knowledge Practices and Multiliteracies* (pp. 43-51). Singapore: Springer.

Lima R. (2013, August 31). Tablet na escolar [Tablet computer in the school]. Retrieved from http://espacoacademico.wordpress.com/2013/08/31/tablets-na-escola/

Lucas, L. (2014). *Tablets em sala de aula: Análise das percepções dos provessores de Matemática na escola pública de Taperoá/PB* [Tablet computers in classroom: Analysis on the perceptions of the Mathmatics teachers in the public school of Taperoá/PB]. Monograph. Universidade Estadual da Paraíba. Retrieved from http://dspace.bc.uepb.edu.br:8080/xmlui/handle/123456789/6478

Maia, D. & Barreto, M. (2012) Tecnologias digitais na educação: Uma análise das políticas públicas brasileiras. *Educação, Formação & Tecnologias,* 5(1), 47-61. ISSN 1646-933X.

McGee, D., & VanderNoor, J. (2013, June 6). Tablet computer adoption programs in high schools. Retrieved from http://280edtech.pbworks.com/w/file/fetch/67603583/Tablet%20Computing%20in%20High%20School%20Dean%20and%20Jeff%206.24.13.docx

Mercadante, A. (2013, July 16). Projeto Tablet Educacional: Entrevista com o Ministro da Educação [Project Educational Tablet: Interview with the Minister of Education]. Retrieved from https://www.youtube.com/watch?v=wLyz0xUGcJ8.

Mewborn, K. N. (2005). *A Grounded Theory study of the multicultural experiences of school of psychologists*. Doctoral Dissertation. University of Maryland.

Ministério da Educação. (n.d.). Índice de Desenvolvimento da Educação Básica [Basic Education Development Index]. Retrieved from http://portal.mec.gov.br/index.php?Itemid=336

Ministério da Educação. (2011a). Portal do Professor [Portal of the Teacher]. Retrieved from http://portaldoprofessor.mec.gov.br/index.html

Ministério da Educação. (2011b, January 13). Mulheres são maioria entre universitários, revela Censo [Women are the majority among universitystudents, reveals Census]. Retrieved from http://portal.mec.gov.br/component/content/article?id=16227

Ministério da Educação. (2012, November 20). Ministro entrega tablets para iniciar formação de professor do ensino médio [Ministry gives tablet computer to the training for high-school teachers]. Retrieved from http://portal.mec.gov.br/index.php?option=com_content&view=article&id=18241:ministro-entrega-tablets-para-iniciar-formacao-de-professor-do-ensino-medio&catid=372:agenda

Minayo, M. C. (1994). *Pesquisa social: Teoria, método e criatividade*. [Social research: Theory, method and criativity]. Rio de Janeiro: Petrópolis.

Moore, E., Utshig, T. T., Haas, K. A., Klein, B., Yoder, P. D., Zhang, Y., & Hayes, M. H. (2008). Tablet PC technology for the enhancement of synchronous distributed education. *IEEE Transactions on Learning Technologies*, 1(2), 105–116.

Morrow, S.L. (2005). Quality and Trustworthness in Qualitative Research in Counseling Psychology. *Journal of Counselling Psychology*, 25, 2, 250 - 260.

Nascimento, A. (2013, January 20). Tablet adotado nas aulas de escolas particulares [Tablet computers are used in private schools]. Retrieved from https://www.alvinhopatriota.com.br/tablet-adotado-nas-aulas-de-escolas-particulares/

Nascimento, F. (2014). *O uso pedagógico do tablet educacional como ferramenta de aprendizagem de alunos do primeiro ano regular do ensino médio* [The pedagogical use of the educational tablet as a learning tool for grade-ten students]. Monograph. Universidade Estadual da Paraíba. Retrieved from http://dspace.bc.uepb.edu.br:8080/xmlui/handle/123456789/4760

Neves, A,. & Cardoso, C. (2013). Os desafios do uso do tablet pelos professores do Ensino Médio das escolas públicas do Distrito Federal. V Simpósio Hipertexto e Tecnologias na Educação, 1, 1.

OECD. (2009). PISA 2009 Findings. Retrieved from http://www.oecd.org/pisa/46643496.pdf

OECD. (2012). PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know. Retrieved from http://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf

Oliveira, D. (2014). Dispositivos móveis no contexto escolar da rede pública: O que pensam professores e alunos sobre o uso de tablete? [Mobile devices in the public school context: What do teachers and students think on the use of tablete computer?]. *Third Conference on Educational Research*. Costa Rica: Universidad de Costa Rica.

Oliveira, M. (2012, December). MP dos royalties viabiliza aplicar 10% do PIB em educação, diz ministro [Bill of the royalties makes feasible the application of 10% of the GDP in education, ministry says]. *G1 Magazine*. Retrieved from http://g1.globo.com/politica/noticia/2012/11/mp-dos-royalties-viabiliza-aplicar-10-do-pib-em-educacao-diz-ministro.html

Pacheco, A. S. V. (2010). *Evasão e permanência dos estudantes de um curso de administração do sistema Universidade Aberta do Brasil: Uma teoria fundamentada em fatos e na gestão do conhecimento* [Evasion and permanence of students in a course of administration from the Open University of Brazil: A theory based on facts and knowledge management]. Doctoral dissertation. Retrieved from EGC (http://btd.egc.ufsc.br/?p=411).

Pamuk, S., Ergun, M., Çakir, R., Yilmaz, H. B., & Ayas, C. (2013). The use of tablet pc and interactive board from the perspectives of teachers and students: Evaluation of the fatih project. *Kuram ve Uygulamada Egitim Bilimleri*, 13(3), 1815–1822. doi:10.12738/estp.2013.3.1734

Paraguassu, L. (2013, January 24). MEC vai distribuir a docentes aulas da Khan Academy [Ministry for Education will distribute Khan Academy lectures among teachers]. *Estadão*

Magazine. Retrieved from http://www.estadao.com.br/noticias/vida,mec-vai-distribuir-a-docentes-aulas-da-khan-academy,985158,0.htm

Park, S. H., & Ertmer, P. A. (2008). Examining barriers in technology-enhancedproblem-based learning: Using a performance support systems approach. *British Journal of Educational Technology*, 39(4), 631-643.

Piso Salarial Profissional Nacional. (n.d.). Piso salarial profissional nacional [National professional minimun wage]. Retrieved from http://portal.mec.gov.br/piso-salarial-de-professores

Plano Nacional de Educação (2014) [National Plan for Education 2014-2024]. Congress Report ISBN 978-85-402-0244-3

Portal Brasil (2012, February 10) Portal do Prfessor já armazena mais de 16 mil conteúdos digitais [Teacher's Portal already hosts more than 16 thousands of digital contents] Retreived from http://www.brasil.gov.br/educacao/2012/02/portal-do-professor-ja-armazena-mais-de-16-mil-conteudos-digitais

Posseti, H. (2012, November 8). Governo negocia conexão Wi-Fi para tablets de professores. Teletime Magazine [Government negotiates Wi-Fi connectivity for teacher's tablete computers]. *ExameMagazine*. Retrieved from http://exame.abril.com.br/tecnologia/noticias/governo-negocia-conexao-wifi-para-tablets-de-professores

Press Department of Paraiba State. (2013, August 30). Governo inicia treinamento sobre uso pedagógico do tablet educacional [Government launches training on pedagogical use of educational tablet]. Retrieved from http://paraiba.pb.gov.br/governo-inicia-treinamento-sobre-uso-pedagogico-do-tablet-educacional/

R7 (2016, January 7) "Não é possível que a idade média de aposentadoria no Brasil seja 55 anos", diz Dilma ["It is not possible that the average retirement age in Brazil be 55 years old," says Dilma]. *R7 Magazine.* Retrieved from http://noticias.r7.com/brasil/nao-e-possivel-que-a-idade-media-de-aposentadoria-no-brasil-seja-55-anos-diz-dilma-07012016

Rissi, M. (2013). *A confiança e as relações interpessoais assegurando o compartilhamento do conhecimento no ambiente virtual de aprendizagem* [The confidence and interpersonal relationships ensuring knowledge sharing in virtual learning environment] Doctoral dissertation. Retrieved from EGC (http://btd.egc.ufsc.br/?p=1367).

Rock, M. (2012, October 5). The future of education: Tablets vs. textbooks. *Mashable.* Retrieved from http://mashable.com/2012/10/05/tablets-vs-textbooks/#DBZhIOGtBmqF

Ross, K. (2005). *Sample design for educational survey research.* Paris: UNESCO.

Sakawee, S. (2013, October 8). Thailand's one tablet per child program rocked by claims of 30% broken tablets. *Techinasia*. Retrieved from http://www.techinasia.com/thailands-tablet-child-program-rocked-claims-30-broken-tablets/

Sakawee, S. (2014, February 3). Thailand's One Tablet Per Child faces another dead end as a Chinese manufacturer cancels the deal. *Tachinasia*. Retrieved from

https://www.techinasia.com/thailands-tablet-child-faces-dead-chinese-manufacturer-cancels-deal/

Santana, B. (2012). *Recursos educacionais abertos: Práticas colaborativas e políticas públicas*. Salvador: Edufba.

Sarantakos, S. (1993). *Social research*. Basingstoke: Macmillan.

Savarese, M. (2012, February 7). Governo anuncia distribuição de 600 mil tablets para ensino médio [Government announces the distribution of 600 thousand tablet computers to high school]. *Educação UOL*. Retrieved from http://educacao.uol.com.br/noticias/2012/02/07/governo-anuncia-distribuicao-de-600-mil-tablets-para-ensino-medio.htm

Savin-Baden, M., & Major, C. (2010). Qualitative Research Synthesis. *In New Approaches to Qualitative Research: Wisdom and Uncertainty* (pp. 108-118). Savin-Baden, M., & Major, C. (eds.). London: Routledge.

Secretaria de Assuntos Estratégicos. (2013, February 14). Comissão estuda modificação nas regras do visto de trabalho para estrangeiros [Commission studies changes in the work visa for foreigners]. Retrieved from http://www.sae.gov.br/site/?p=14828

SEDUC/AM (n.d). Projeto alunos e multimeios [Students and multimedia project]. Retrieved from https://sites.google.com/site/ntemanausplanaltoam/inscricoes-em-cursos/projeto-alunos-e-multimeios

SEDUC/PR. (n.d.). Programas e projetos da sala de aula conectada do Paraná [Programs and projects of the connected classroom of Paraná]. Retrieved from http://www.gestaoescolar.diaadia.pr.gov.br/modules/conteudo/conteudo.php?conteudo=508

Shaffhauser, D. (2015, February 9). A better way to find the right OER. *Campus Technology.* Retrieved from https://campustechnology.com/articles/2015/09/02/a-better-way-to-find-the-right-oer.aspx

Sikolia, D., Biros, D., Mason, M., & Weiser, M. (2013). Trustworthiness of Grounded Theory methodology research in information systems. *MWAIS 2013 Proceedings*, Paper 16.

Sommerich, C. M., Ward, R., Sikdar, K., Payne, J., & Herman, L. (2007). A survey of high school students with ubiquitous access to tablet PCs. *Ergonomics,* 50(5), 706–27. doi:10.1080/00140130701194793

Soubbotina, T. P,. & Sheram, K. A. (2000). *Beyond economic growth: Meeting the challenges of global development.* Washington, DC: World Bank.

Souza, L. (2014). *Os desafios da utilização dos tablets em uma escola do ensino médio de Aparecida/PB* [The challenges of the use of tablet computers in a high school in Aparecida/PB]. Monograph. Universidade Estadual da Paraíba. Retrieved from http://dspace.bc.uepb.edu.br:8080/xmlui/handle/123456789/4771

Spillers, F. (2009, November 4). Making Things Easier with Tablet computing? Demystifying Usability. Retrieved from http://www.demystifyingusability.com/2009/11/making-things-easier-with-tablet-computing.html

Stern, P. N. (1980). Grounded theory methodology: its uses and processes. *Journal of Nursing Scholarship*, 12(1), 20–3.

Stranz, E. (2008). Estudos fiscais: estimativa de participação dos entes da federação no bolo tributário [Tax studies: estimate of participation of the stackholders of the federation in the tax cake]. Retrieved from http://portal.cnm.org.br/sites/9000/9070/Estudos/Financas/EstudoBoloTributario.pdf

Sundquist, M. (2013). Big data and the survival of the scientific method. Retrieved from http://badhessian.org/2013/10/big-data-and-the-survival-of-the-scientific-method/.

Tablet computer. (n.d.). In PC Magazine dictionary. Retrieved from http://www.pcmag.com/encyclopedia/term/52520/tablet-computer

Taffarel, C., & Albuquerque, J. (2011, January 5). Educação pública x educação privada: A disputa da década no ínicio do século XXI [Public education x private education: The contest of the decade in the beginning of the XXI century]. *Rascunho Digital*. Retrieved from http://www.rascunhodigital.faced.ufba.br/ver.php?idtexto=842

Takarnia, M. (2015, May 18). Professores de seis estados e de pelo menos sete municípios estão em greve [Teachers from six states and at least seven municipalities are on strike]. *Empresa Brasileira de Comunicação*. Retrieved from: http://www.ebc.com.br/educacao/2015/05/professores-de-seis-estados-e-de-pelo-menos-sete-municipios-estao-em-greve

Tamim, R. M., Borokhovski, E., Pickup, D., & Bernard, R. M. (2015). *Large-scale, government-supported educational tablet initiatives*. Burnaby, BC, Canada: Commonwealth of Learning.

Tamim, R. M., Borokhovski, E., Pickup, D., & Bernard, R. M. (2015). Tablet Initiatives. Burnaby, BC, Canada: Commonwealth of Learning.

Tanous, J. (2013, January 7). iPad Market Share to Grow Due to Increased Enterprise Adoption - *The Mac Observer*. Retrieved from http://www.macobserver.com/tmo/article/ipad-market-share-to-grow-due-to-increased-enterprise-adoption

Teleco. (2016, April 30). Estatísticas de celulares no Brasil. Retrieved from http://www.teleco.com.br/ncel.asp

Teles, G. (2012, February 2). Governo federal distribuirá 600 mil tablets para escolas públicas [Federal government will distribute 600 thousand tablete computers for public schools]. Jornal da Globo. *G1 Magazine*. Retrieved from http://g1.globo.com/jornal-da-globo/noticia/2012/02/governo-federal-distribuira-600-mil-tablets-para-escolas-publicas.html

Terra. (2012a, December 21). Taxa de desemprego no Brasil é a segunda menor da história [Unemployment rate in Brazil is the second lowest in history]. *Terra Magazine.* Retrieved from http://economia.terra.com.br/taxa-de-desemprego-no-brasil-e-a-2-menor-da-historia-aponta-ibge,e22891f473790410VgnCLD200000bbcceb0aRCRD.html

Terra. (2012b, August 14). País supera meta no Ideb, mas ensino médio piora em 9 Estados [Country gets over Ideb goal, but the high-school education get worse in 9 states]. *Terra Magazine.* Retrieved from http://noticias.terra.com.br/educacao/pais-supera-meta-no-ideb-mas-ensino-medio-piora-em-9-estados,50bb42ba7d2da310VgnCLD200000bbcceb0aRCRD.html

Terra. (2013, August 6). Mercadante defende tablets no ensino: 'Aluno é digital, nós somos analógicos' [Mercadante defends tablet computers in education: ‘The student is digital, we are analogic’]. *Terra Magazine.* Retrieved from http://noticias.terra.com.br/educacao/mercadante-defende-tablets-no-ensino-aluno-e-digital-nos-somos-analogicos,c98150f186450410VgnVCM4000009bcceb0aRCRD.html

Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, 27(2), 237–246. doi:10.1177/1098214005283748

TI Inside. (2015, April 6). Vendas de smartphones crescem 55% no Brasil em 2014 [Smartphone sales grow 55% in Brazil in 2014]. *TI Inside.* Retrieved from http://convergecom.com.br/tiinside/06/04/2015/vendas-de-smartphones-crescem-55-no-brasil-em-2014/#.VYzGdOewlK4

Today's Zaman. (2015, January 15). Turkish techno-classroom program faces failure. *HighBeam Research* Retrieved from https://www.highbeam.com/doc/1G1-397497350.html

Todos Pela Educação. (2016, May 3). [Retrieved data related to registered 4-17 year old students in schools]. Educação no Brasil [Education in Brazil]. Retrieved from

http://www.todospelaeducacao.org.br/indicadores-da-educacao/5-metas?task=indicador_educacao&id_indicador=9#filtros

Tront, J. G. (2007). Practices through a large-scale tablet personal computer deployment. *IEEE Computer Society*, 40(9), 62–68.

UNESCO (2016). Diferent meanings of "curriculum." Retrieved from http://www.unesco.org/new/en/education/themes/strengthening-education-systems/quality-framework/technical-notes/different-meaning-of-curriculum

University of Maryland (n.d.) What is digital inclusion. Retrieved from http://digitalinclusion.umd.edu/content/what-digital-inclusion

UOL. (2013, March 14). Brasil tem terceira maior taxa de evasão escolar entre 100 países, diz Pnud [Brazil has the third biggest school drop out rate among 100 countries, according to Pnud]. *UOL Education.* Retrieved from http://educacao.uol.com.br/noticias/2013/03/14/brasil-tem-3-maior-taxa-de-evasao-escolar-entre-100-paises-diz-pnud.htm

Valor Econômico. (2014, June 26). Dilma sanciona sem vetos plano que destina 10% do PIB à educação [Dilma sanctions without vetoes plan that aims 10% of GDP to education]. *Valor Econômico.* Retrieved from http://www.valor.com.br/politica/3594928/dilma-sanciona-sem-vetos-plano-que-destina-10-do-pib-educacao/

Valstad, H. (2010). *iPad as a pedagogical device.* Monograph. Norwegian University of science and technology. Retrieved from http://www.iktogskole.no/wp-content/uploads/2011/02/ipadasapedagogicaldevice-110222.pdf

Valstad, H. (2011). *Introducing the iPad in a Norwegian high school: How do students and teachers react to this technology*. Master thesis. Norwegian University of Science and Technology.

Ventura, I. (2012, December 12). Professores vão receber 6.200 tablets em Minas Gerais [Teachers will receive 6,200 tablets in Minas Gerais]. *Portal Arcos.* Retrieved from http://www.hojeemdia.com.br/horizontes/professores-v-o-receber-6-200-tablets-em-minas-gerais-1.67172

Vergara, S. C. (1997). *Projetos e relatórios de pesquisa em administração.* [Research projects and reports in management]. São Paulo: Atlas.

Verge. (2011, December 7). Android: A visual history. Retrieved from http://www.theverge.com/2011/12/7/2585779/android-history

Viriyapong, R., & Harfield, A. (2013). Facing the challenges of the One-Tablet-Per- Child policy in Thai primary school education. *International Journal of Advanced Computer Science and Applications*, 4(9), 176–184.

Viriyapong, R., & Harfield, A. (2013). Facing the challenges of the One-Tablet-Per-Child policy in Thai primary school education. *International Journal of Advanced Computer Sciences and Applications*, 4(9), 176–184.

W3Techs. (2016, May 3). Usage of content languages for websites. Retrieved from http://w3techs.com/technologies/overview/content_language/all

Wagner, T. (2011, June 24). Seven Skills Students Need for Their Future |*Educate to Innovate with STEM.* Retrieved from https://portlandwizkid.wordpress.com/2011/06/24/7-skills-students-need-for-their-future/

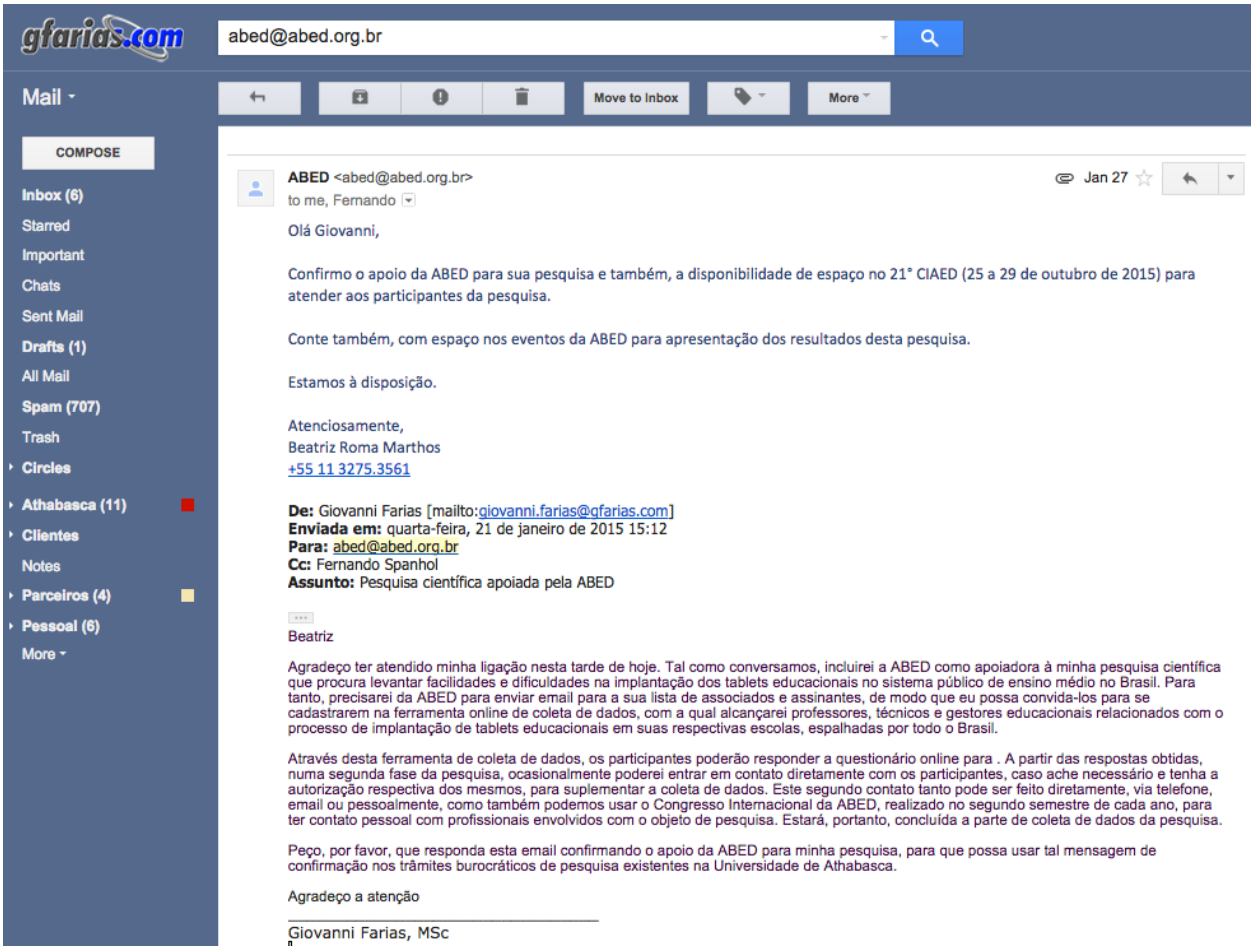
Wang, P.-Y., & Huang, C.-K. (2015). The Effect of Visual Cueing and Control Design on Children's Reading Achievement of Audio E-books with Tablet Computers. *Journal of Curriculum and Teaching*, 4(1), 96–107. doi:10.5430/jct.v4n1p96

Whitefield, T. (2012). Pedagogy in the evolving tech environment: What has changed? In *ICICTE 2012* (pp. 283–291).

World Bank. (n.d.). GPD per capita. Retrieved from http://data.worldbank.org/indicator/NY.GDP.PCAP.CD

Appendix A

Support letter from the Brazilian Association for Distance Education



gfarias.com

abed@abed.org.br

Mail

Move to Inbox | More

COMPOSE

Inbox (6)
Starred
Important
Chats
Sent Mail
Drafts (1)
All Mail
Spam (707)
Trash
Circles
Athabasca (11)
Clientes
Notes
Parceiros (4)
Pessoal (6)
More

ABED <abed@abed.org.br> Jan 27
to me, Fernando

Olá Giovanni,

Confirmo o apoio da ABED para sua pesquisa e também, a disponibilidade de espaço no 21° CIAED (25 a 29 de outubro de 2015) para atender aos participantes da pesquisa.

Conte também, com espaço nos eventos da ABED para apresentação dos resultados desta pesquisa.

Estamos à disposição.

Atenciosamente,
Beatriz Roma Marthos
+55 11 3275.3561

De: Giovanni Farias [mailto:giovanni.farias@gfarias.com]
Enviada em: quarta-feira, 21 de janeiro de 2015 15:12
Para: abed@abed.org.br
Cc: Fernando Spanhol
Assunto: Pesquisa científica apoiada pela ABED

Beatriz

Agradeço ter atendido minha ligação nesta tarde de hoje. Tal como conversamos, incluirei a ABED como apoiadora à minha pesquisa científica que procura levantar facilidades e dificuldades na implantação dos tablets educacionais no sistema público de ensino médio no Brasil. Para tanto, precisarei da ABED para enviar email para a sua lista de associados e assinantes, de modo que eu possa convida-los para se cadastrarem na ferramenta online de coleta de dados, com a qual alcançarei professores, técnicos e gestores educacionais relacionados com o processo de implantação de tablets educacionais em suas respectivas escolas, espalhadas por todo o Brasil.

Através desta ferramenta de coleta de dados, os participantes poderão responder a questionário online para . A partir das respostas obtidas, numa segunda fase da pesquisa, ocasionalmente poderei entrar em contato diretamente com os participantes, caso ache necessário e tenha a autorização respectiva dos mesmos, para suplementar a coleta de dados. Este segundo contato tanto pode ser feito diretamente, via telefone, email ou pessoalmente, como também podemos usar o Congresso Internacional da ABED, realizado no segundo semestre de cada ano, para ter contato pessoal com profissionais envolvidos com o objeto de pesquisa. Estará, portanto, concluída a parte de coleta de dados da pesquisa.

Peço, por favor, que responda esta email confirmando o apoio da ABED para minha pesquisa, para que possa usar tal mensagem de confirmação nos trâmites burocráticos de pesquisa existentes na Universidade de Athabasca.

Agradeço a atenção

Giovanni Farias, MSc

Appendix B

Letter of information for the research participant

English Version

September 23rd, 2015

Principal Researcher:
Giovanni Farias, MSc.
giovanni.farias@gfarias.com

Supervisor:
Mohamed Ally, PhD.
mohameda@athabascau.ca

You are invited to take part in a research project entitled '*Tablet computers in public school systems in Brazil: Factors that influence a high-scale deployment'*.

This form is part of the process of informed consent. The information presented should give you the basic idea of what this research is about and what your participation will involve, should you choose to participate. It also describes your right to withdraw from the project. In order to decide whether you wish to participate in this research project, you should understand enough about its risks, benefits and what it requires of you to be able to make an informed decision. This is the informed consent process. Take time to read this carefully as it is important that you understand the information given to you. Please contact the principal investigator, Giovanni Farias if you have any questions about the project or would like more information before you consent to participate.

It is entirely up to you whether or not you take part in this research. If you choose not to take part, or if you decide to withdraw from the research once it has started, there will be no negative consequences for you now, or in the future.

Introduction

My name is Giovanni Farias and I am a Doctor of Education in Distance student at Athabasca University. As a requirement to complete my degree, I am conducting a research project about the high-scale deployment of tablet computers in Brazilian public school districts, especially in what concerns to the factors that influence this process. I am conducting this project under the supervision of professor Mohamed Ally, PhD.

Why are you being asked to take part in this research project?

You are being invited to participate in this project because you have or had some direct or indirect contact with the tablet computer deployment initiative cited above. Thus, you might have information and a formed opinion on what is important to consider when having such kind

of initiative. If you do not have any relationship with the deployment of tablet computers in Brazilian public schools, please, do not participate of this research.

What is the purpose of this research project?

The purpose of this research is to investigate what are the main factors that influence the deployment of tablet computers in Brazilian public schools when it happens in high-scale. We hope to identify these factors and find possible relationship among them in order to map them accordingly with grade of importance to the deployment process.

What will you be asked to do?

At first, you just need to complete an online survey, with few questions about your personal and professional profiles and your impressions on the deployment process above cited, based on the experience you have or had on this topic. You may complete survey any time until November 30th, 2015. It takes take around 15 minutes. Occasionally, based on your initial participation, you might be contacted by email or phone and an interview might be schedule to clarify some aspect of your response. Any follow-up conversation by phone or in person will be recorded just to generate a transcript which will be submitted to your review and approval, in a way that you will be able to alter or clarify your comments. After your approval, any the audio recording file related to your interview will be deleted.

What are the risks and benefits?

There is no direct benefit for you by participating of this research. However, your participation will collaborate to raise substantial information about the reality of deploying a large-scale number of tablet computers in the Brazilian public school districts. The development of knowledge on this matter may bring substantial improvements for a more realistic development of education policy involving such kind of devices in public education in Brazil. Moreover, by participating of the initial phase of this study by responding the survey, you might win a tablet computer Samsung Galaxy Tab 7". The prize will be raffled among those that completed the survey with reasonable responses by the end of the data collection phase.

Do you have to take part in this project?

As stated earlier in this letter, involvement in this project is entirely voluntary. Then, you can give up of answering the survey at any time during the online collection. If you decide to withdraw your participation after to start completing the survey, you just need to send an email to Giovanni Farias requesting the withdrawal. No withdrawal will be possible after December 10th, 2015, when the consolidation of the collected data begins and when the raffled prize will be delivered to the winner.

How will your privacy and confidentiality be protected?

The online survey works with an encrypted technology that protects the survey responses from being captured during the transmission from your device (computer, tablet computer or smartphone) to the server of the company that will host the online survey. This server is protected against invasion and unauthorized access to the data is something unlikely to happen. Unless you explicitly authorize on the contrary, no other people but the researcher and his supervisor will have access to your survey responses. For further information about the technology security involved with the data collection, please refer to Survey Monkey security policy, which can be found at the following link: https://www.surveymonkey.com/mp/policy/security/.

How will my anonymity be protected?

Every reasonable effort will be made to ensure your anonymity. The principal researcher undertakes not to share any information that allows your identification with any other person. The raw data analysis will happen without your personal information. Each response will be tagged with a number, and only the principal researcher will have conditions to identify who is the participant related to each survey response. The exceptions for anonymity protection are whether in case of some legislation or a professional code of conduct requires that it be reported, or if you explicitly authorize the publication of any data that identifies you as a participant of this study. Any information you provide that cannot lead to your identification is enable to be published.

How will the data collected be stored?

All the data collected will be protected by the security system provided by the online survey service (Survey Monkey). After being transferred to the principal researcher's password-protected computer, by December 10th, 2015, the data will be protected by cryptography. By December 2016, all the raw data collected from the research will be permanently deleted, without chances of recovery. Only consolidated information, which does not allow any identification of this study participants, will be kept for the future use.

The on-line survey company Survey Monkey is located in the United States. The US Patriot Act allows authorities to access the records of Internet service providers. Therefore, anonymity and confidentiality cannot be totally guaranteed. If you choose to participate in this survey, you understand that your responses to the survey questions will be stored for a time (i.e. until it is transferred from that company's server to the principal researcher's computer) and may be accessed by the US national security agencies during that time. The Survey Monkey privacy policy can be found at the following link: https://www.surveymonkey.com/mp/policy/privacy-policy/.

Who will receive the results of the research project?

The existence of the research will be listed in an abstract posted online at the Athabasca University Library's Digital Thesis and Project Room and the final research paper will be publicly available. The principal researcher undertakes to notify the participants by email on how

to access the dissertation document, as soon as it is available for public access. Notice that the research paper might have direct quotations, either in summarized form or not, based on the information you provided during the data collection. These quotations with have your identification only when explicitly authorized.

Who can you contact for more information or to indicate your interest in participating in the research project?

Thank you for considering this invitation. If you have any questions or would like more information, please contact me by the e-mail giovanni.farias@gfarias.com or my supervisor by mohameda@athabascau.ca. If you are ready to participate in this project, please proceed to review the following consent and respond the survey.

Thank you.

Giovanni Farias

This project has been reviewed by the Athabasca University Research Ethics Board. Should you have any comments or concerns regarding your treatment as a participant in this project, please contact the Research Ethics Office by e-mail at rebsec@athabascau.ca **or by telephone at 1-800-788-9041, ext. 6718.**

Informed Consent:
By completing this survey you agree that:

1. You have read what this research project is about and understood the risks and benefits.
2. You have had time to think about participating in the project and had the opportunity to ask questions and have those questions answered to your satisfaction.
3. You understand that you are free to withdraw participation from the project by closing your browser window or navigating away from this page, without having to give a reason and that doing so will not affect you now or in the future.
4. You understand that if you choose to withdraw, you may request that your data be removed from the project by contacting the principal investigator before December 10th, 2015.

Please retain a copy of this consent information for your records.

Clicking the button below and submitting this survey constitutes your consent and implies your agreement to the above statements.

Portuguese Version

23 de setembro de 2015

Pesquisador Principal:
Giovanni Farias, MSc.
giovanni.farias@gfarias.com

Supervisor:
Mohamed Ally, PhD.
mohameda@athabascau.ca

Você é convidado para participar de um projeto de pesquisa entitulado: "Tablets educacionais em sistemas de escolas públicas no Brasil: Fatores que influenciam uma implantação em larga escala."

Este formulário é parte do processo de comunicação de consentimento. A informação apresentada deve dar para você uma ideia básica do que se trata esta pesquisa e o que envolve sua participação, e se você deve escolher participar. Também descreve seu direito de se retirar do projeto. Para você decidir se você deseja participar deste projeto de pesquisa, você deve entender suficientemente sobre os riscos, benefícios e o que é requerido de você para que esteja apto a tomar uma decisão de forma consciente. Despenda um tempo para ler isso cuidadosamente uma vez que é importante que você entenda a informação dada para você. Por favor, contate o investigador principal, Giovanni Farias, se você tiver qualquer questão sobre o projeto ou se precisar de mais informações antes de você consentir participar.

É totalmente dependente de você participar ou não desta pesquisa. Se você escolher não participar, ou decidir sair da pesquisa uma vez iniciada, não haverá qualquer consequências negativas para você agora ou no futuro.

Introdução

Meu nome é Giovanni Farias e eu sou um estudante de doutorado em Educação a Distância na Universidade de Athabasca. Como exigência para completar meu doutorado, eu estou conduzindo um projeto de pesquisa sobre implantação em larga escala de tablets educacinais em distritos escolares públicos brasileiros, especialmente no que se relaciona aos fatores que influenciam este processo. Eu estou conduzindo este projeto sob a supervisão de professor Mohamed Ally, PhD.

Por que você está sendo convidado para fazer parte deste projeto de pesquisa?

Você está sendo convidado para participar deste projeto porque você tem ou teve algum contato direto ou indireto com a iniciativa de implantação de tablet educacional acima. Assim, você pode ter informação e ter uma opinião formada sobre o que é importante considerar quando se tem tal tipo de iniciativa. Se você não tem qualquer relação com a implantação de tablets educacionais em escolas públicas brasileiras, por favor, não participe desta pesquisa.

Qual é a proposta deste projeto de pesquisa?

A proposta desta pesquisa é investigar quais são os principais fatores que influenciam a implantação de tablets educacionais em escolar públicas brasileiras quando isso ocorre em larga escala. Nós esperamos identificar estes fatores e achar possíveis relações entre eles para mapea-los de acordo com o grau de importância ao processo de implantação.

O que você será solicitado a fazer?

A princípio, você só precisará completar um questionário online, com poucas questões sobre seu perfil pessoal e profissional e suas impressões sobre o processo de implantação acima citado, baseado na experiência que você tem ou teve sobre este tópico. Você pode completar o questionário em qualquer data até 30 de novembro de 2015. Leva aproximadamente 15 minutos. Ocasionalmente, baseado em sua participação inicial, você pode ser contatado via email ou fone e uma entrevista poderá ser marcada para esclarecer alguns aspectos de suas respostas. Qualquer conversação por telefone ou pessoalmente será gravada apenas para gerar transcritos que serão submetidos para sua revisão e aprovação, de forma que você poderá alterar ou clarear comentários. Depois de sua aprovação, qualquer gravação de áudio relacionado com sua entrevista será deletada.

Quais os tipos de riscos e benefícios?

Não há qualquer benefício direto por sua participação nesta pesquisa. Entretanto, sua participação irá colaborar com o aumento substancial da informação sobre a realidade de implantação em larga escala de tablets educacionais em distritos escolares públicos brasileiros. O desenvolvimento de conhecimento sobre essa matéria pode trazer melhoras substanciais para um desenvolvimento mais realista de políticas educacionais que envolvam tal tipo de dispositivo em educação pública no Brasil. Além do mais, ao participar da fase incial deste estudo respondendo o questionário, você poderá ganhar um tablet Samsung Galaxy Tab 7". O prêmio será sorteado entre aqueles que responderem completamente o questionário com respostas razoáveis até o fim da fase de coleta de dados.

Você tem que fazer parte deste projeto?

Tal como citado antes nesta carta, envolvimento neste projeto é completamente voluntário. Então, você pode desistir de sua participação depois de completar o questionário, apenas necessitando enviar um email para Giovanni Farias solicitando sua retirada. Nenhuma retirada será possível após 10 de dezembro de 2015, quando a consolidação dos dados coletados começam e quando o prêmio será enviado para o ganhador.

How will your privacy and confidentiality be protected?

The online survey works with an encrypted technology that protects the survey responses from being captured during the transmission from your device (computer, tablet computer or smartphone) to the server of the company that will host the online survey. This server is protected against invasion and unauthorized access to the data is something unlikely to happen. Unless you explicitly authorize on the contrary, no other people but the researcher and his

supervisor will have access to your survey responses. For further information about the technology security involved with the data collection, please refer to Survey Monkey security policy, which can be found at the following link: https://www.surveymonkey.com/mp/policy/security/.

Como meu anonimato estará protegido?

Todo esforço razoável será feito para assegurar seu anonimato. O pesquisador principal se compromete a não compartilhar qualquer informação que permita sua identificação com qualquer outra pessoa. A análise dos dados brutos será feita sem sua informação pessoal. Cada resposta será marcada com um número e apenas o pesquisador principal terá condições de identificar quem é o participante relacionado com cada resposta de pesquisa. As exceções à proteção do anonimato ocorrem em caso de código legislativo ou profissional de conduta requerer denúncia, ou se você explicitamente autorizar a publicação de qualquer informação que lhe identifique como participante deste estudo. Qualquer informação que você prover e que não possa levar à sua identificação é passível de ser publicada.

Como os dados coletados serão estocados??

All the data collected will be protected by the security system provided by the online survey service (Survey Monkey). After being transferred to the principal researcher's password-protected computer, by December 10th, 2015, the data will be protected by cryptography. By December 2016, all the raw data collected from the research will be permanently deleted, without chances of recovery. Only consolidated information, which does not allow any identification of this study participants, will be kept for the posterity.

Todos os dados coletados seão protegidos pelo sistema de segurança oferecido pels serviço online de questionários (Survey Monkey). Depois serão transferidos para o computador protegido por senha do pesquisador principal em 10 de dezembro de 2015, os dados serão protegidos por criptografia. Até dezembro de 2016, todos os dados brutos coletados na pesquisa serão permanentemente deletados, sem chances de recuperação. Apenas informações consolidadas, as quais não permite qualquer identificação dos participantes do estudo, serão mantidas para a posteridade.

A empresa de questionários online Survey Monkey é localizada nos Estados Unidos. A Lei Patriota americana permite a autoridades acessarem os arquivos de provedores de serviço de Internet. Portanto, anonimato e confidencialidade não podem ser totalmente garantidos. Se você escolher participar desta pesquisa, você entende que suas respostas ao questionário estarão armazenadas for um tempo (ou seja, até serem transferidas do servidor da empresa para o computador do pesquisador principal) e poderão ser acessadas por agências de segurança nacinal dos Estados Unidos durante este período. A política de privacidade da empresa Survey Monkey pode ser achada no seguinte link: https://www.surveymonkey.com/mp/policy/privacy-policy/.

Quem receberá os resultados do projeto de pesquisa?

A existência da pesquisa sera listada em um resumo postado na Biblioteca Digital de Teses e Sala de Projetos da Universidade de Athabasca, e o artigo final da pesquisa estará publicamente disponível. O pesquisador principal notificará os participantes por email sobre como acessarem o documento de tese, tão logo esta esteja disponível para acesso público. Note que o artigo de pesquisa pode ter citações, resumidas ou não, baseado na informação que você fornecer durante a coleta de dados. Estas citações terão sua identificação apenas quando explicitamente autorizadas.

Quem você deve contatar para obter mais informações ou indicar seu interesse em participar deste projeto de pesquisa?

Obrigado por considerar este convite. Se você tiver qualquer questão ou quiser mais informação, por favor, contate me pelo email giovanni.farias@gfarias.com ou meu supervisor através do email mohameda@athabascau.ca. Se você estiver pronto para participar deste projeto, por favor proceda para rever o seguinte consentimento e responder ao questionário.

Obrigado

Giovanni Farias

Este projeto foi auditado pelo Comitê de Ética em Pesquisa da Universidade de Athabasca. Caso tenha qualquer comentário ou preocupação relacionado com o seu tratamento como participante, por favor, contate o Escritório de Ética em Pesquisa por email rebsec@athabascau.ca **ou por telefone 1-800-788-9041, ext. 6718.**

Comunicação de Consentimento:
Ao completar este questionário você concorda que:

1. Você leu do que se trata este projeto de pesquisa e entendeu os riscos e benefícios.
2. Você teve tempo para pensar sobre participar no projeto e teve a oportunidade de fazer perguntas e teve todos os seus questionamentos respondidos satisfatoriamente.
3. Você entende que está livre para desistir de participar do projeto de pesquisa fechando a janela do navegador ou navegando para outra página qualquer, sem ter que dar explicações e que fazendo isso não afetará você nem agora nem no futuro.
4. Você entende que se você escolher desistir, você pode requerer que seus dados sejam removidos do projeto contatando o pesquisador principal antes do dia 10 de dezembro de 2015.

Por favor, mantenha uma cópia desta informação de consentimento para seus registros.

Clicando o botão abaixo e submetendo este questionário constitui seu consentimento e implica sua concordância aos termos acima.

Appendix C

Online survey questions

PERSONAL PROFILE

1 Last Name:
First Name:
Middle name:
Open-ended question - short answer

2 Email
Open-ended question - short answer

3 Phone
Open-ended question - short answer

4 Age
Ordinal scale question - one choice within the range 18-70
Choices in menu drop down: 18-25, 26-30, 31-40, 41-50, 51-65

5 Gender
Closed-ended question - one choice between: male and female
a) Male
b) Female

PROFESSIONAL PROFILE

6 Highest education level
Closed-ended question - multiple choices allowed among the following options:
a) High school
b) Diploma or certificate
c) Bachelor degree
d) Master degree
e) Doctoral degree

7 How many years of professional experience in education sector do you have?
Ordinal scale question - one choice within the range 0-30
Choices in menu drop down: 1, 2, 3, 4…28, 29, 30.

8 What is your role in the deployment of tablet computers in public schools?
If you are a teacher, please, indicate the subject matter(s) that you teach.
Open-ended question - short answer

QUESTIONS REGARDING THE TABLET COMPUTERS IN HIGH SCHOOLS

9 What are your impressions about the deployment process of the tablet computers?
Open-ended question - long answer

10 Could you indicate some factors that you consider important for the tablet computer deployment in schools in Brazil?
Open-ended question - long answer

11 Describe any positive or negative experience you have lived or observed in this tablet computer deployment process in schools.
Open-ended question - long answer

12. Please provide any other comments you may have on the deployment process.

Appendix D

Online Letter of Consent

English Version

Principal Researcher:
Giovanni Farias, MSc.
giovanni.farias@gfarias.com

Supervisor:
Mohamed Ally, PhD.
mohameda@athabascau.ca

You are invited to participate in a research study about the high-scale roll out of tablet computers in Brazilian public school districts, especially in what concerns to the factors that influence this deployment process. I am conducting this study as a requirement to complete my doctoral degree.

As a participant, you are asked to participate in this study by completing a short online questionnaire about the main factors that influence the deployment of tablet computers in Brazilian public schools. Participation will take approximately 15 minutes of your time.

Involvement in this study is entirely voluntary and you may refuse to answer any questions or to share information that you are not comfortable with. You may withdraw from the study at any time during the data collection period by sending an email to giovanni.farias@gfarias.com.

Results of this study will be available in the doctoral dissertation for which this data collection is being done, at Athabasca University dissertation repository. Moreover, they may be published in scientific journals or presented in scientific conferences. Please note that the survey data may be initially collected and stored on a server in the U.S. and is subject to access under the U.S. Patriot Act until it is transferred from that server to the researcher's computer.

All electronic data will be kept encrypted in a password-protected computer at my office. All electronic records will be deleted when all project requirements have been met, approximately by June 2021.

If you have any questions about this study or require further information, please contact Giovanni Farias or Mohamed using the contact information above.

This study has been reviewed by the Athabasca University Research Ethics Board. Should you have any comments or concerns regarding your treatment as a participant in this study, please contact the Office of Research Ethics at 1-800-788-9041, ext. 6718 or by e-mail to rebsec@athabascau.ca.

Thank you for your assistance in this project.
CONSENT: The completion of the survey and its submission is viewed as your consent to participate.

Portuguese Version

Principal Pesquisador:
Giovanni Farias, MSc.
giovanni.farias@gfarias.com

Supervisor:
Mohamed Ally, PhD.
mohameda@athabascau.ca

Você é convidado a participar de um estudo de pesquisa sobre implantação em larga escala de tablets educacionais em distritos escolares brasileiros, especialmente no que concerne aos fatores que influenciam este processo de implantação. Eu estou conduzindo este estudo como requerimento para completar meu doutorado.

Como participante, você será solicitado a responder um pequeno formulário online sobre os principais fatores que influenciam a implantação de tablets educacionais nas escolas públicas brasileiras. A participação levará aproximadamente 15 minutos de seu tempo.

O envolvimento neste estudo é completamente voluntário e você poderá se recusar a responder qualquer das questões ou compartilhar informação com a qual você não se sinta confortável. Você pode solicitar sua saída do estudo em qualquer momento durante o período de coleta de dados mandando um email para giovanni.farias@gfarias.com.

Os resultados deste estudo estarão disponíveis na tese de doutorado para a qual esta coleta de dados está sendo feita, no repositório de teses da Universidade de Athabasca. Além do mais, eles podem ser publicados em jornais científicos ou apresentados em conferências científicas. Por favor, note que os dados do questionário podem ser inicialmente coletados e transferidos de um servidor para o computador do pesquisador.

Todos os dados eletrônicos serão criptografados mantidos em um computador protegido por senha em meu escritório. Todos os arquivos eletrônicos serão apagados quando todos os requisitos de projeto forem atendidos, aproximadamente até junho de 2021.

Se você tem quaisquer questionamentos sobre este estudo ou deseja maiores informações, por favor contate Giovanni Farias ou Mohamed usando as informações de contato acima.

Este estudo foi auditado pelo Comitê de Ética em Pesquisa da Universidade de Athabasca. Caso você tenha qualquer comentários ou preocupações sobre o seu tratamento como um participante desta pesquisa, por favor contate o Escritório de Ética em Pesquisa pelo fone 1-800-788-9041, ext 6718 ou por email para rebsec@athabascau.ca.

Obrigado pela sua participação neste projeto.

CONSENTIMENTO:
Ao responder e submeter este questionário é visto como seu consentimento para participação.

Appendix E

Table of categories, codes, and descriptions used in this research

This table lists the categories used to compose the model of large-scale tablet computer deployment in Brazilian public schools. This table presents the codes originally generated during the first open coding process and the description that guided the use of the respective category during the rest of the coding process.

Category	Codes	Description
Auditing	• Auditing • Teacher assessment	Any citation related to assessing the outcomes from the use of tablet computers by teachers, the learning outcomes obtained, or the use of the tablet itself for other purposes than education.
Content	• Content • Regional apps • Apps • Online content resources • Documentation • Copyright	Any citation related to content published available for the teachers, as well as the content generated by teachers to be used by others. It can be an app, document, or an online resource. It also includes any legal issues that the teacher must master to deal with content copyright.
Curriculum	• Curriculum • Educational planning that fits in the new IT context	Any citation related to development or adjustment of curriculum to fit the use of tablet computers for educational purposes.
Digital inclusion	• Digital inclusion • IT Knowledge	Any citation related to having the resources, the skills, and the demand for using tablet computers or any other technology for educational purposes, regardless the training

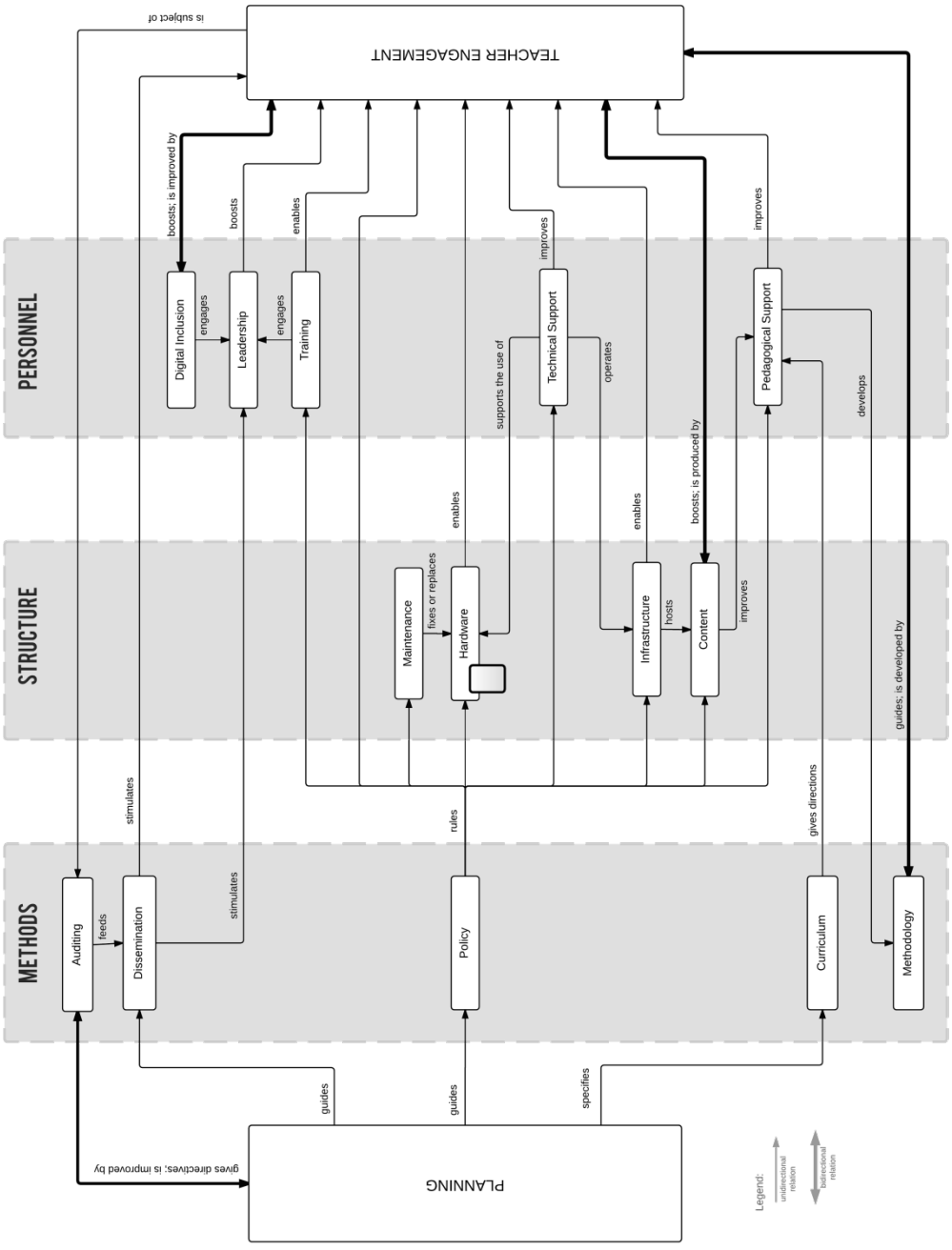
		provided specifically to use the mobile device.
Dissemination	• Dissemination • Communication • Advertisement of the new paradigm	Any citation related to the dissemination of the paradigm and the potential outcomes from the use of tablet computers in schools, besides the needed structure and attitudes to get results from it. All stakeholders must get involved with the deployment: policymakers, managers, principals, teachers, support teams, and even students and their parents in the case of device distribution among students.
Hardware	• Hardware • Equipment cost • Hardware quality • Battery • Little space memory	Any citation regarding the hardware features: facility of use, durability, performance, capacity, cost, logistics for distribution, etc.
Infrastructure	• Infrastructure • Power outlets • Internet connection • Wi-Fi • Projectors	Any citation related to all the structure needed to support the use of tablet computers in school in what regards to energy, presentation equipment's, Internet connection, equipment's for content production, etc.
Leadership	• Leadership • Principal engagement	Any citation related to the emergence of formal and informal leadership, as well as the engagement of this leadership in the deployment.
Maintenance	• Maintenance • Logistics to send/return devices	Any comment on the equipment fix or replacement, including the logistics needed to send broken devices to maintenance and to return

		the fixed devices to the operation.
Methodology	• Methodology • Pedagogical planning • Guidelines for the use of tablet computers within the classroom context	Any citation related to the developed methodology or pedagogical plans for using tablet computers in the educational context.
Other factors	• Social problems at night classes • Politics influencing education	Any factor that is not related to the other codes, it is not directly related to the deployment process, and it is applied to a very specific context of one school.
Pedagogical Support	• Pedagogical support • Instructional design	Any kind of action or resource dedicated to guide the teacher on how pedagogically to use the technology in education.
Planning	• Planning • Planning with focus on IT • One tablet per child	Any citation related to any kind of planning action for the tablet computer deployment as a whole.
Policy	• Policy • Rules for using the infrastructure	Any citation related to the action of establishing operational rules and protocols for the use of tablet computers in the school context.
Teacher Engagement	• Teacher engagement • Knowledge sharing • Innovation • Work load	Any citation related to the teacher engagement with (or resistance against) the activities needed for the use of tablet computer in the pedagogical or operational contexts.
Technical Support	• Technical support • Help to master the use of the equipment	Any citation related to action or resource dedicated to helping teacher in the use of IT resources or to solve problems regarding technological aspects of the use of tablet computers

		or related equipment.
Training	• Training • Coaching • Knowledge acquisition	Any citation related to the training needed to make the teachers able to deal with the mobile device in the school context.

Appendix F

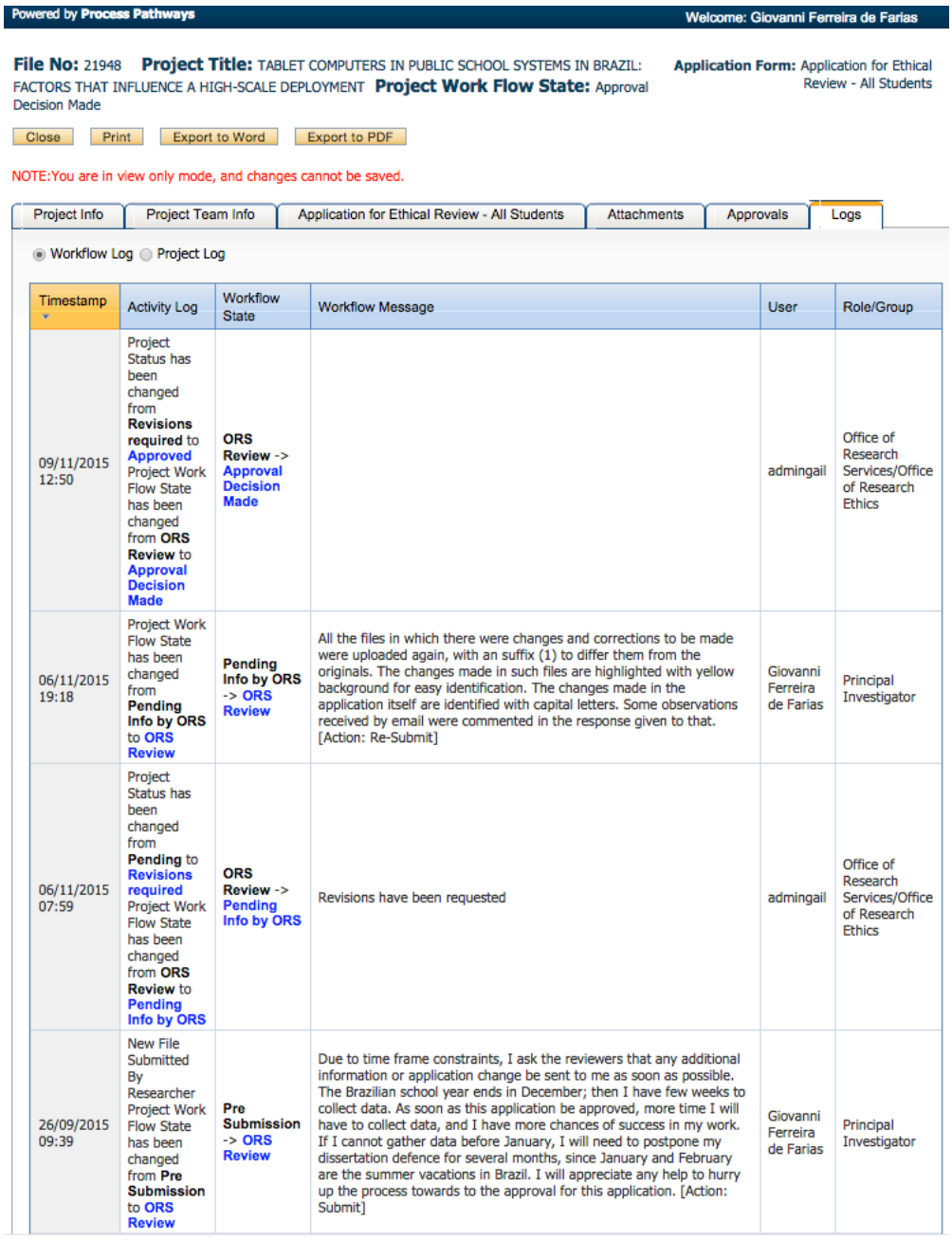
Alternative LSMDD model design that highlights its classes of factors



Appendix G

Research Ethics Board Approval

Image printed from Athabasca University Research Portal: file N°. 21948



Powered by **Process Pathways** — Welcome: Giovanni Ferreira de Farias

File No: 21948 **Project Title:** TABLET COMPUTERS IN PUBLIC SCHOOL SYSTEMS IN BRAZIL: FACTORS THAT INFLUENCE A HIGH-SCALE DEPLOYMENT **Project Work Flow State:** Approval Decision Made

Application Form: Application for Ethical Review - All Students

Close | Print | Export to Word | Export to PDF

NOTE:You are in view only mode, and changes cannot be saved.

Project Info | Project Team Info | Application for Ethical Review - All Students | Attachments | Approvals | Logs

Workflow Log | Project Log

Timestamp	Activity Log	Workflow State	Workflow Message	User	Role/Group
09/11/2015 12:50	Project Status has been changed from **Revisions required** to **Approved** Project Work Flow State has been changed from **ORS Review** to **Approval Decision Made**	**ORS Review** -> **Approval Decision Made**		admingail	Office of Research Services/Office of Research Ethics
06/11/2015 19:18	Project Work Flow State has been changed from **Pending Info by ORS** to **ORS Review**	**Pending Info by ORS** -> **ORS Review**	All the files in which there were changes and corrections to be made were uploaded again, with an suffix (1) to differ them from the originals. The changes made in such files are highlighted with yellow background for easy identification. The changes made in the application itself are identified with capital letters. Some observations received by email were commented in the response given to that. [Action: Re-Submit]	Giovanni Ferreira de Farias	Principal Investigator
06/11/2015 07:59	Project Status has been changed from **Pending** to **Revisions required** Project Work Flow State has been changed from **ORS Review** to **Pending Info by ORS**	**ORS Review** -> **Pending Info by ORS**	Revisions have been requested	admingail	Office of Research Services/Office of Research Ethics
26/09/2015 09:39	New File Submitted By Researcher Project Work Flow State has been changed from **Pre Submission** to **ORS Review**	**Pre Submission** -> **ORS Review**	Due to time frame constraints, I ask the reviewers that any additional information or application change be sent to me as soon as possible. The Brazilian school year ends in December; then I have few weeks to collect data. As soon as this application be approved, more time I will have to collect data, and I have more chances of success in my work. If I cannot gather data before January, I will need to postpone my dissertation defence for several months, since January and February are the summer vacations in Brazil. I will appreciate any help to hurry up the process towards to the approval for this application. [Action: Submit]	Giovanni Ferreira de Farias	Principal Investigator