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Paula Lüderitz de Albuquerque Lenz-Cesar
(Paula Albuquerque)

Trajectory of digital documentation and reflective practice: making teaching visible, critical, and shareable

Tese de Doutorado

Thesis presented to the Programa de Pós-Graduação em Educação of PUC-Rio in partial fulfillment of the requirements for the degree of Doutora em Educação.

Advisor: Profª. Magda Pischetola

Rio de Janeiro
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Profª. Magda Pischetola
Orientadora
Departamento de Educação – PUC-Rio

Prof. Ralph Ings Bannell
Departamento de Educação – PUC-Rio

Profª. Hermengarda Alves Lüdke - Menga Lüdke
Departamento de Educação – PUC-Rio

Profª. Pâmela Suélli da Motta Esteves
Universidade Estadual do RJ - UERJ

Profª Lone Dirckinck Holmfeld
Aalborg University - AAU

Rio de Janeiro, 13 de fevereiro de 2020.

Paula Lüderitz de Albuquerque Lenz-Cesar

Paula Albuquerque has a bachelor's degree in Economics and Mathematics from Federal University of Rio de Janeiro (UFRJ) and Santa Ursula University respectively. She has a Master's degree in Math Education from Boston University. Paula has worked in both private and public schools in Brazil and the U.S., and also at universities. She has been a classroom teacher for more than 20 years. Her main interest is in digital technology and how it can impact teachers' reflective practice, also participating in teaching education programs. She is currently a member of the Fortec Group at PPGE/PUC-RJ, which carries out research about teacher training and technology.

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To all public teachers who don't give up; who make a daily commitment to the young bodies, minds and hearts in front of them.
… and to me! I deserve it!

But even more and mostly, to MY DAD, a bulwark of kindness and love.

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It is impossible to go far alone. We find greatness and enjoy the journey when we walk together.

It is curious to think that all words, thoughts, decisions, choices, and movements result from interaction. I am grateful that my journey has been full of good hearts and large smiles.

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Truly, thank you all.

Abstract

Albuquerque, Paula Lüderitz de: Pischetola, Magda. **Trajectory of digital documentation and reflective practice: making teaching visible, critical, and shareable**. Rio de Janeiro, 2019. 249p. Tese de Doutorado - Departamento de Educação, Pontifícia Universidade Católica do Rio de Janeiro.

Enacted teaching practices are invisible and mysterious. Critical reflective teachers are the ultimate goal of any teacher training. The goal of this research is to investigate whether teaching documentation work can be considered an instrument for fostering reflection, and to reveal pedagogical scenes (Margolinas and Rivière, 2005) and the contents used for planning and teaching. The study was carried out in the city of Rio de Janeiro - Brazil. We visited 80 public middle schools in all 11 educational districts, we talked to about 200 teachers, conducted 78 surveys based on an intentionally selected sample, and conducted one focus group and 12 semi-structured interviews. We used grounded theory and results were analyzed in light of the fundamental concepts in our theoretical framework such as reflection, documentation work, and ICT in education. Our results indicated an interaction between teachers and available resources (focus on technical, digital resources) to organize, create, extend, transform, remix, and share content, suggesting teachers' reflective attitude during documentation genesis. We specifically investigated pedagogical documentation work and what it entails: motivations, purpose and use. The (oral, concrete, and visual) materials observed indicated that teachers' motivation was more instrumental and pragmatic, with few transformative intents; moreover, there was little evidence of proactive, deliberate and intentional reflection such as retrospection on the practices just realized. Nevertheless, their attitudes and opinions suggested their genuine interest in improving their practices, and they believe that this can be stimulated through digital tools, recognizing documentation as a powerful one. Our discussion points to the limitations of our theoretical framework in explaining teachers' documental genesis and its relation to reflective attitude. We acknowledge the need for a theory that recognizes and explains material agency (in our case, of digital technology), such as the Material Engagement Theory (MET).

Keywords

Documentation; reflection; material engagement theory; digital technology; practice; registration; teacher; middle school.

Resumo

Albuquerque, Paula Lüderitz de: Pischetola, Magda. **Trajetória da documentação digital e da prática reflexiva: tornando a prática docente visível, crítica e acessível**. Rio de Janeiro, 2019. 249p. Tese de Doutorado - Departamento de Educação, Pontifícia Universidade Católica do Rio de Janeiro.

Práticas didáticas realizadas são ditas como invisíveis e misteriosas. Professores críticos e reflexivos são o objetivo máximo de qualquer curso de formação de professores. O objetivo deste estudo é investigar se o trabalho de documentação do professor pode ser considerado como um instrumento que promove reflexão, e que revela as cenas pedagógicas (Margolinas e Rivière, 2005), e o conteúdo utilizado para o planejamento e o ensino. O estudo foi realizado na cidade do Rio de Janeiro (Brasil). Visitamos 80 escolas públicas de ensino fundamental II de todas as 11 corregedorias regionais de educação (CREs), falamos com cerca de 200 professores, coletamos 78 questionários de uma amostra intencionalmente selecionada, e conduzimos um grupo focal e 12 entrevistas semi-estruturadas. Utilizamos grounded theory para analisar os dados de acordo com os conceitos fundamentais do nosso referencial teórico: reflexão, documentação pedagógica e TIC na educação. Os resultados indicaram uma interação entre professores e recursos disponíveis (foco nos recursos digitais) para organizar, criar, expandir (extend), transformar, remixar, e compartilhar conteúdo, sugerindo uma atitude reflexiva por parte dos professores durante o seu trabalho de gênese documental. Nós investigamos especificamente o trabalho de documentação do professor, o que o compõe: motivações, intenções e uso. O material observado (oral, concreto, e virtual) indicou que a motivação do professor é mais instrumental e pragmática, com poucas intenções transformadoras; além disso, houve pouca evidência de uma reflexão proativa, deliberada e intencional, como por exemplo um olhar retroativo para as práticas recém realizadas. No entanto, suas atitudes e opiniões sugeriram um interesse genuíno na melhora de suas práticas e uma crença de que esta melhora pode ser promovida através de ferramentas digitais; no caso o trabalho de documentação sendo reconhecido como um caminho promissor. Nossa discussão indica as limitações do nosso referencial teórico para explicar a gênese documental do professor e como ela se relaciona com uma postura reflexiva. Nós reconhecemos a necessidade de uma teoria que reconheça e explique a agência da matéria (no nosso caso, das tecnologias digitais), como a Teoria Sócio Material (Material Engagement Theory - MET).

Palavras-chave

Documentação; reflexão; teoria sócio-material; tecnologia digital; prática; registro; professor; ensino fundamental.

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Foreword

Before presenting this work, I would like to give a brief explanation about why this work was done in English, despite my nationality and the fieldwork done at Brazilian public schools. My explanation is broken down into four points, one related to authenticity, one related to facility, one related to visibility, and finally, one related to possibility.

Authenticity: Most of my theoretical framework was grounded on international research, English and French pretty much. After starting to read theses, articles and books in Portuguese, I realized that they were directing me to primary literature in those two languages. So I went there and, after not much time, most of my reading was being done in English.

Facility: Since I read well and fast in English, it seemed much easier to read those resources directly rather than searching for secondary literature (scarcer by the way) and relying on translations.

Visibility: English is indeed a world language, and as such documents in the language are accessible worldwide. This fed into the desire that such work, dedication, commitment and research could be reachable by the greatest number of students and teachers, by researchers, professors and professionals in the field.

Possibility: Having done my master's degree in the United States and worked as a teacher in international schools, writing in English was real and fun possibility. I am well aware that the original data had to be translated. And I am sensitive to the fact that some colleagues will not have access to this work done in a foreign language. However, I am also pretty sure that work done and written in a doctorate does not usually reach the greater public. And so be it: A big piece of work available to numerous people from different countries, and more accessible, lots of talks, papers, sharing, and writing done in Portuguese, for me, and for all of us who somehow care about education, best practices and student learning.

Twenty-five years back I made the decision to learn, seek, live and study everything I could about education; the mysterious and too complex process of learning; when we develop skills, find answers and create a multitude of new questions. It always amazed me how learning happened, how people in general, and children more specifically, engage in sensitive and cognitive experiences and expand their understanding about the world and about themselves as part of that world.

My journey involved three degrees (Economics, Mathematics, and Teaching), and a Master's Degree in Mathematics Education. After 20 years teaching teenagers in private and public schools, for a disadvantaged population and in a very exclusive community; adults in special education programs; and graduate students on Engineering and Teaching courses, I found that, despite the physical, social and cultural circumstances that make any teaching-learning process unique and a challenge, there were somethings during the interaction between teachers and learners that intrigued me. How does learning happen? What makes a good teacher? How can you be a good one? How can good practice be defined? Can we reproduce a successful one?

After much reading, teaching, discussing and sharing with colleagues, I decided to pursue higher education. My motivation strengthened and my focus was always to investigate certain, specific practices as potential instruments for reflecting, for collaborating between partners, and to allow /help good teaching and specific knowledge become visible.

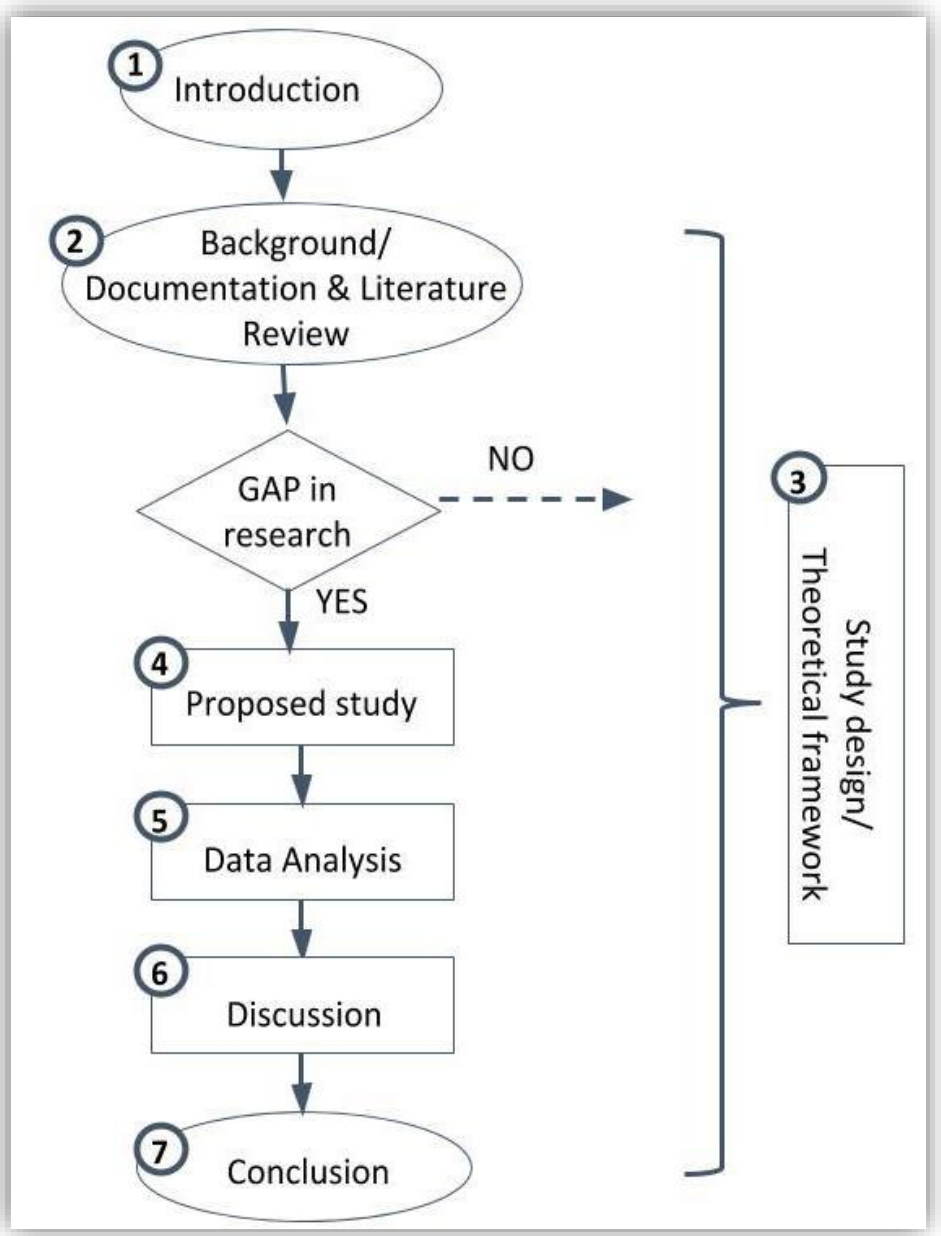
This is the resulting work of my journey.

I hope it contributes with information and ideas not only to improve and unveil teaching practices, but also to pursue further studies.

In chapter 1, we present an introduction, an historical context, our object of study and the main concepts on which we will be grounding our investigation. Chapter 2 introduces a review of literature and an analysis of existing, related work. In

addition, it puts forward a background discussion about the documentation process. Chapter 3 details the study design, the theoretical framework adopted and the main constructs that will support the data analysis and discussion. Chapter 4 details the proposed study and the methodology, followed by the data analysis in chapter 5. Chapter 6 features a discussion of the findings, and in the last chapter we will present our conclusion. See the structure of the thesis below (figure 1).

Figure 1 - Organization map



1
INTRODUCTION

"Even if you have already taken a long walk, there will always
be one more way to go."
Saint Augustine

Generally speaking, education as a process to acquire knowledge, to facilitate learning, and to explore explanations and the comprehension of natural, cultural and social phenomena appears to be a shared social wish, despite historical, economic and geographic differences. Human nature, its creativity and capacity to make connections and relate to others foster the willingness to learn and to know about new things. Education is related to the notions of autonomy, happiness, critical thinking, clarity of thought, virtue, justice, human rights, and fulfillment. Indeed, education is key for human development and the development of abilities and competencies.

It is well known that education is not a prerogative of school only; however, schools are undeniably the main structured spaces where most individuals search for, develop, and appreciate knowledge. When we mention "schools", we mean a well-established institution organization in which there is interaction among teachers and students; we mean curriculum and socialization, and also processes involving mentors and pupils[1]. More specifically, thinking about school education requires us being aware of its economic and social contexts; it means thinking attentively about teachers' training and practice, to reflect upon teaching practice and the curriculum, and mostly, to understand that any pedagogical process is unique, situated, historical, and authentic. Shulman (1986) calls "wisdom of practice" the development of expertise acquired 'on-the-job'. For the author, the most popular form of knowing extends to using informal resources, such as interacting, speaking to others, reading, and searching on the internet. Critical reflection plays a key role in the process of examining your own practice and evaluating resources to be used to deepen and broaden any acquired knowledge,

[1]We are aware of the pretty idealistic view; in reality schools rarely feature such structure, organization and dynamics among the parties involved.

as well as to consider any transformational cycle resulting from unresolved dilemmas.

This study is situated in the field that investigates teaching practices, more specifically, the genesis of the teacher documentation process. Some authors (Gueudet and Trouche, 2012; Neuenfeldt et al., 2014; Rocha and Trouche, 2017; Rodrigues, 2014) argue that "pedagogical documentation is an element that assists in the exercise of thinking about teaching practices and ends up being a key instrument for renewing the teaching process and all that it entails"[2] (Neuenfeldt et al. 2014). In that sense, pedagogical documentation is a fundamental element that allows teachers to question, investigate, and create, besides engaging in reflective practice, which certainly has a central role in any desired transformation that could lead to both conceptual and practice changes.

The motivation behind this study is based on the belief that being a critical and reflective teacher is a good indicator of a professional who is ethically and pedagogically committed to the teaching and learning process. Rodgers (2016) called it a "matter of integrity" (p. 71); he agrees with Shön (1983) and affirms that reflective practice is how a professional thinks in action; it is the only way in which professionals (in our case, teachers) can deal with the complex, unique and on-going dilemmas that constitute their daily work.

But the motivation goes further; we also believe that documentation work helps to develop reflective critical habits and that media and technology facilitate and enhance this process.

Before explaining the concept of "documentation" in more details and what we will call the documentation process, we believe it is necessary to situate our investigation in place and time to better discern and interpret the forces acting within our field of investigation: middle school public teachers actively working in Rio de Janeiro's public schools. From a socio-constructivist perspective, any educational process reflects the environment and the natural conditions where it takes place as well as the existing social interactions (Vygotsky, 1980). Such a scenario will influence public policies, educational discourse, and teaching practice, all of which will have a result on the quality of learning and the overall development of citizens and the different capacities of a specific population. Our

[2]Translated by the author.

research was undertaken in the city of Rio de Janeiro, Brazil. It is important that we understand some specificities about the place and the country to which it belongs to (section 1), and the object of our study (section 2).

In addition, we will present the review of literature in chapter 2, with a background about the concept of documentation work, and the theoretical framework in chapter 3. The methodology is explained in chapter 4 followed by the data analysis (chapter 5). We discuss our results in chapter 6 and offer a conclusion in chapter 7.

1.1. Historical Context

Despite the similarities in educational processes, it is important to situate our study in place and time. In this section, we will discuss some of the history of Brazil and the city of Rio de Janeiro; the place that its education has in the national scenario and some data illustrating the current educational situation. In this vain, we will consider some of the peculiarities and challenges of our field of investigation.

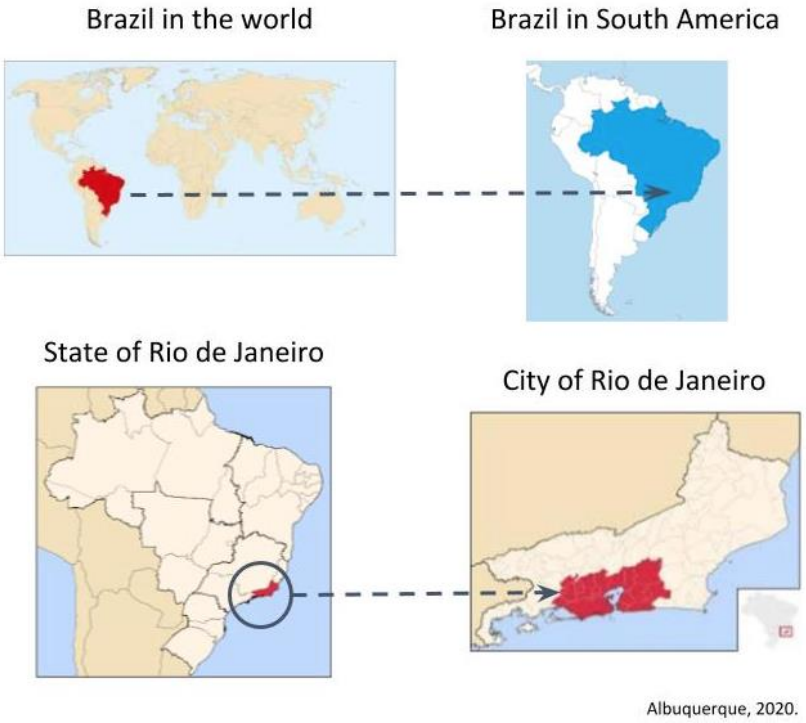
1.1.1. The big picture with numbers

Brazil is a Portuguese-speaking tropical country situated in South America. It is the fifth largest country in the world with an area of about 8.510.0003 km2 divided into 26 states and a federal district where the state capital is. It has more than 209 million inhabitants4, being the fifth most populated country in the world (see figure 2).

[3] Almost 3 290 000 mi^2.

[4] https://www.ibge.gov.br/apps/populacao/projecao/

Figure 2. Brazil, State of Rio de Janeiro, City of Rio de Janeiro



At the end of 2018, 12.2% of the Brazilian population over 14 years of age was unoccupied, and the monthly average income for those who had an occupation was R$ 2,137 in the local currency[5] ("Real"); about 540 U.S. dollars[6].

When investigating the context in Brazil, we need to consider that the country has continental dimensions, and substantial differences between its five main regions (Northeast, North, Central-west, Southeast, and South). Those discrepancies are not only due to geographical aspects such as topography and weather conditions but also due to their history and culture. It is important to analyze each region (each state and each city) separately in order to better understand the peculiarities of their dynamics and challenges (see figure 3). It is clear that the South and the Southeast of Brazil have much better economic conditions than the North and Northeast regions[7]. Among other factors, this

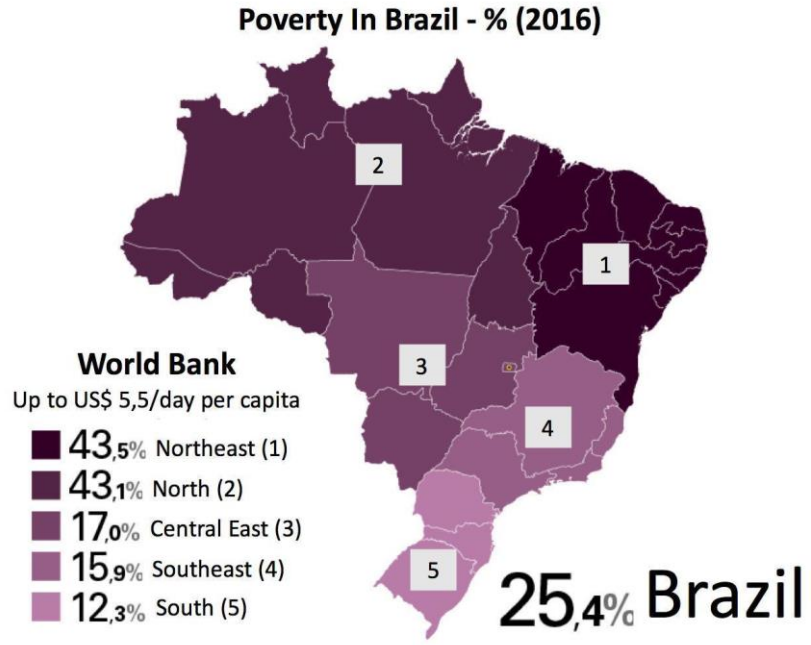
[5]https://www.ibge.gov.br/estatisticas/sociais/trabalho/9173-pesquisa-nacional-por-amostra-de-domicilios-continua-trimestral.html?=&t=quadro-sintetico

[6]https://www.bcb.gov.br/estabilidadefinanceira/fechamentodolar. Accessed on December 16th, 2019. Rate of 1 U.S. dollar = 4,0801 reais.

[7]IFDM - *Índice Firjan de Desenvolvimento Municipal* (an index about education based on oficial public statistics, calculated yearly and by municipality). Available at: https://www.firjan.com.br/ifdm/

discrepancy is caused by and is also the cause of an overall deficiency in all educational spheres in the second group of regions.

Figure 3. Brazil and its 5 main regions



Source: Agência IBGE[8]

The Brazilian Gini index[9] is 5.515, which guarantees its position among the 10 most unequal countries in the world[10]. However, the country is not exactly poor and miserable all over; yet it is quite socially and economically unequal. According to data from PNAD 2016[11], 10% of the population with the highest income hold almost 45% of all the wealth, and the 10% with the least income hold only about 0,8% of the total.

Investment in education in Brazil accounts for about 6% of GDP[12], a higher rate than in some OECD countries, but its education indicators are still far from

[8]https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/18825-um-quarto-da-populacao-vive-com-menos-de-r-387-por-mes

[9]For more detailed information about the meaning of the GINI Index please refer to: https://www.investopedia.com/terms/g/gini-index.asp

[10]https://oglobo.globo.com/economia/brasil-o-10-pais-mais-desigual-do-mundo-21094828

[11]Article published at: https://economia.ig.com.br/2017-11-29/concentracao-renda-ibge.html

[12]http://agenciabrasil.ebc.com.br/educacao/noticia/2018-07/brasil-gasta-6-do-pib-em-educacao-mas-desempenho-escolar-e-ruim

acceptable[13] from a social justice and human rights point of view, and there is much yet to be done. For example, about 30% of Brazilians between 15 and 64 years old are considered functionally illiterate[14]: they can read but are not able to understand and to draw basic hypothesis from a simple written text.

1.1.2. Rio de Janeiro: the State and its capital

Rio de Janeiro is the third most populated state and is located in the southeast part of the country (see figure 2). It covers an area of about 44,000 km^2 and has more than 17 million inhabitants. Its capital is also called Rio de Janeiro, the second largest city in Brazil with more than 6.5 million inhabitants[15]. To describe the city with some data from after 2010, the average monthly income is R$ 2,155.00 (about U$ 528[1617]), 46% of the students of 18 years of age have not graduated from high school, 17% of the houses do not have sewage treatment, and about 8% of the population is unemployed[18].

Our study is situated in the City of Rio de Janeiro, but even in this much smaller region, the discrepancies are considerable and represent a shocking socio-economic contrast observed all around the area. The south zone is the richest and most developed one, with 13 of its neighborhoods occupying the top 15 positions[19] when comparing social development indices. This area has an HDI[20] of 0,901 and some neighborhoods, such as *Gávea* and *Leblon* have an even higher rate (0,970 and 0,967 respectively), being comparable with Nordic countries. However, in that same zone, we have the second largest shanty town (*favela*) of

[13]Education at a Glance 2018: OECD Indicators - Brazil. Available at: https://read.oecd-ilibrary.org/education/education-at-a-glance-2018/brazil_eag-2018-73-en#page1

[14]INAF (2018): http://acaoeducativa.org.br/wp-content/uploads/2018/08/Inaf2018_Relat%C3%B3rio-Resultados-Preliminares_v08Ago2018.pdf

[15]IBGE: https://cidades.ibge.gov.br/brasil/rj/rio-de-janeiro/panorama

[16]https://www.bcb.gov.br/estabilidadefinanceira/fechamentodolar. Accessed on December 16th, 2019. Rate of 1 U.S. dollar = 4,0801 reais.

[17] All conversions will use the same exchange rate as in footnote number 17.

[18]Information from CENSO/IBGE, 2010; PNUD/ONU, 2013, SNIS, 2015, and CENSO/IBGE, 2015. All organized on the site http://casafluminense.org.br/mapa-da-desigualdade/

[19]http://portalgeo.rio.rj.gov.br/estudoscariocas/download/2394_%C3%8Dndice%20de%20Desenvolvimento%20Social_IDS.pdf

[20]HDI is defined by the United Nations and considers variables such as a long and healthy life, knowledge, and a decent standard of living. For more information about HDI see the United Nations Development Programme - Human Development Reports ate the site http://hdr.undp.org/en/content/human-development-index-hdi.

Brazil; *Rocinha* houses about 70 thousand people and has an HDI of 0,732, lower than the country's average of 0,755. Actually, 22% of Rio's population lives in *favelas*, where health, education, and security conditions are precarious. Most of the *favelas* are developed at and lie around some of the hills close to the most developed areas, where the population can take advantage of existing job opportunities without having to commute long distances using a very poor, scarce and unreliable public transportation system. The North and West zones also have a low HDI of 0,771 and 0,742 respectively[21] and they contain the poorest neighborhoods in the City (see figure 4 below).

Figure 4. Zones of Rio de Janeiro

Such discrepancies reinforced our decision to consider in our study public schools in all of the zones. The idea was to gather data from diverse regions, allowing the investigation in very different contexts and with a heterogeneous public.

1.1.3. Education in history

Brazil had his first republican constitution in 1891, however, political habits (centralization of power and *coronelismo*[22]), together with an uneducated

[21] http://www.rio.rj.gov.br/dlstatic/10112/6165511/4162028/analise_idhm_rio_v4_compur.pdf

[22] For more information about *Coronelismo* see https://cpdoc.fgv.br/sites/default/files/verbetes/primeira-republica/CORONELISMO.pdf, e "Origens, desenvolvimento e aspectos do

population removed the subject of “education” from any possible important place in the document[23].

Only after many years, in 1934, a new Constitution was promulgated, which aimed at improving the general social, cultural and economic condition of the majority of the population. However, that text was rapidly invalidated by the establishment of a dictatorship in Brazil. In 1946 a new Constitution established a democratic system, ending the dictatorship, restoring freedom of belief and of speech, among many other rights. In 1964, there was a military coup with a series of amendments that resulted in a new constitution, in 1967, which was modified again in 1969. In 1988 a new Constitution recognized the end of the military regime and once more democracy was restored; the document established political and social rights (see figure 5 for the relationship between Constitution and education rights) and granted special attention to Education.

It was only in 1996 that a specific law, entitled *Lei de Diretrizes e Bases da Educação Nacional*[24] - *LDBEN* (BRASIL, 1996), was promulgated in order to guarantee access to free public education, to value all the professions related to education and their specific qualifications, to detail responsibilities in all spheres of political administration, and to focus on the development of abilities and competencies related to the stakeholders.

All these changes concerning education in general reflected the current political environment with its central theories and related curriculum. As figure 5 suggests, there is a clear *zig-zag* movement on the role of public administration concerning people’s educational rights.

Brazil has made some progress in the area education, such as providing basic education for almost all its population, assuring the allocation of public resources, and expanding the higher education system; however, quality of learning is still a goal to be achieved. It has not been easy to overcome the historical constraints affecting education, such as an unequal society and discontinuity of policies.

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coronelismo” (Oliveira, 2017) available at https://periodicos.fclar.unesp.br/semaspas/article/download/10249/ 6887.

[23]http://www.ambito-juridico.com.br/site/index.php?n_link=revista_artigos_leitura&artigo_id=5610

[24]Federal site - entire Law on :http://www.planalto.gov.br/ccivil_03/leis/l9394.htm; comments about the LDB on: https://www.infoescola.com/educacao/lei-de-diretrizes-e-bases-da-educacao/

Ribeiro (2011) considers three main educational reforms in Brazil in the years 1961, 1971, and since 1982. All of these changed the structure of schools and visibly expanded primary and secondary systems, defending the universalization of education in terms of primary education for all. However, some things did not change much, such as the poor level of learning in general and the differences in opportunities given to those of different race, gender, and socio-economic status.

Figure 5. Constitutions and education[25]

We can affirm that the improved quality[26] of education has not ensured better equality in the access, continuity, and performance of all social groups. For example, the difference in achievement between men and women, between black and white people, and when comparing different social classes in Brazil, is pretty significant and steady over time. Not surprisingly, the Math scores of the group of

[25]https://daniellixavierfreitas.jusbrasil.com.br/artigos/144779190/o-direito-a-educacao-nas-constituicoes-brasileiras

[26]For the concept of *quality of education,* see Alves, Soares and Xavier, 2016 p. 53.

"white males with a better social condition" in *Prova Brasil*[27] are about 42 points higher[28] than those for black women from a lower social class. This difference accounts for about two grade levels (Alves, Soares, and Xavier, 2016).

A discussion about the political framework and pedagogical theories behind the history of education in Brazil, however, is beyond the scope of this study. Our goal is just to give an overview of the path taken until the current situation of Brazilian education and its public schools.

1.1.4
Recent data - overview of the field

Although every year increasingly more individuals have access to schools, an ever smaller number completes high school, and even fewer continue their studies on to graduate level. As expected, public schools in the urban and more developed areas tend to offer better quality education. This is the case of the city of Rio de Janeiro. However, despite the city being in one of the most developed regions in Brazil (Southeast region), even the most developed zone in the State of Rio (South zone, with the highest IDEB[29]) still produces based results in terms of student achievements, teacher qualifications and overall physical school infrastructure. Just to illustrate, the city of Rio de Janeiro has an IDEB (an education quality indicator) of 4.7 (scale 0 to 10); only 21% and 42% of the students learned the required material for Mathematics and Portuguese respectively by the end of middle school years; more than 80% of the teachers in the city's[30] public middle schools receive up to R$ 6500,00 before taxes per month (about U$ 1650,00)[31], and at least two-thirds have not engaged in specific

[27] *Prova Brasil* is a nationwide, standard exam for primary schools focused on the assessment of Portuguese and Mathematics learning. Find more information on the official site: http://portal.mec.gov.br/prova-brasil

[28] Scores from *Prova Brasil* (a standard test in Brazil) from years 2005 through 2013 (Alves, Soares and Xavier, 2016).

[29] IDEB is an indicator for the quality of education that combines information from the performance of students in national assessments at the end of school levels of basic education (4/5th, 8/9th and 11/12th grades) with flow rates. This indicator makes it possible to monitor the country's education systems. For more information, see https://www.oecd.org/pisa/aboutpisa/3.%20Luiz %20Costa_June_2013%20-%20IDEB%20OCDE.pdf

[30] The City of Rio de Janeiro

[31] This data does not consider other sources of income in addition to teaching.

or general continued education during the last couple of years[32]. Some schools do not have a bathroom inside the school building, and one-third of the schools do not provide a meal for students[33].

Despite the negative scenario, we can mention investments in technology in education in Brazil[34] (as all around the world), and in the City of Rio, as now technology has been included in the national educational curricular principles[35]. With the ICT changing and modeling most relations and forms of knowledge acquisition[36], it is essential that technology also participate in \ teaching and learning processes, thereby being used as pedagogical resources to communicate, motivate, research, display, write, calculate, create and so forth. In the city of Rio de Janeiro, we find that 95% of the schools have internet and 90% have broadband[37], although there are controversies about what percentage refers to those with actually functioning and available internet [38].

1.1.5. Some challenges and concerns

After painting an overall picture about the situation of Education in Brazil and in the City of Rio de Janeiro, we now want to share some information about a few challenges and worries existing in any discourse or real action related to Education.

During the past 20 years, there has been an impressive expansion of higher education in Brazil; the country's population has increased 12%[39], whereas the enrollment in higher education has increased by more than 100% in that same

[32] https://qedu.org.br

[33] https://qedu.org.br

[34] Based on CETIC data until 2014 (http://data.cetic.br/cetic/explore?idPesquisa=TIC_EDU), 97% of public schools had computers, but only 40% of them had more than 20 computers; 89% of public schools in southeast area of Brazil had updated computers, but no more than 37% of those schools used the school's internet for didactic objectives. Only 9% of public schools in the area had broadband internet with a speed exceeding 10 megabytes. In 2013, only 24% of public schools in the area participated in the PROINFO program (http://portal.mec.gov.br/proinfo), and only 5% were included in the program to improve broadband at schools.

[35] The federal directives for basic education in Brazil (national common curricular directives - BNCC) require and prescribe the use of technology as a teaching and learning strategy in all areas of interest. For the text and how they recommends it, see Appendix 11.

[36] Such as with the use of electronic spreadsheets, educational softwares, videos, 3D pictures and more.

[37] https://qedu.org.br

[38] See data from TIC Educação at https://www.cetic.br/pesquisa/educacao/

[39] https://veja.abril.com.br/brasil/populacao-brasileira-cresce-menos-nos-anos-2000/

period (Almeida and Ernica, 2015). This data would be more encouraging if, on the other hand, we did not have poor quality basic education[40], which, in general, is not good enough to guarantee, without certain affirmative policies, public students' admission into the public universities and colleges in Brazil (which are usually the best)[41][42].

The unfair game goes beyond admissions processes; inequality also exists when we look closer at the courses that disadvantaged students are actually able to attend and complete. Carvalhes et al. (2013) point out that, despite affirmative action referred to as *Lei de Cotas*[43], the results of which are not yet conclusive, we already know that, despite its positive aspects, such affirmative action[44] does not reverse inequality between regions and inside different groups (Alves et al. 2016). In addition, student retention in secondary school deprives the disadvantaged students of competing for a place at a public university. Data from IBGE[45] says that more than 16,5% of students aged between 15 and 17 years do not go to school. Not surprisingly, retention and truancy (only 83% of the students have an attendance of 75% or more) are the result of issues starting in preceding years. A longitudinal study shows that, despite the improvement in the discrepancy between age and grade level rate, when we consider district public middle schools

[40]We would like to point that the results of public educational system involve many factors such as the geographic location of the schools, available human resources, social and economical background, etc.

[41]Students from private schools represent 75,3% of the students enrolled in graduate studies, whereas only 24,7% come from the public educational system.

[42]In 2012, 37% of the students enrolled in public universities and similar public institutions came from the private system, compared to 40% in 2017. Also, 61% of those enrolled in private graduate institutions came from the public educational system, compared to 71% in 2017 (INEP, 2018a, 2018b).

[43]In Brazil the *Lei das Cotas* ("Quota Law"), was approved in August 2012 after more than ten years of intense, controversial debate. It is a gender, race and social level-based quota used for admissions into public federal universities in Brazil. It establishes that half of the federal universities positions must be filled with students from the public education system, with a specific percentage reserved for the black and native population. Since then the government has committed to improving the condition of the disadvantaged social-racial-ethnic group of young citizens, facilitating their access to quality education, which has a negative correlation with involvement with violence and all that it entails (Soares, 2007).

[44]It is worth drawing attention to the fact that different policies are needed in different moments and for different groups of people, and also that longitudinal studies are important to evaluate better the efficiency of policies about cultural and historical changes; however, despite the yet inconclusive studies, the improvement from the participation of the more disadvantaged groups in the higher education system is undeniable. (Guarnieri and Melo-Silva, 2017). For more information about the Brazilian Quota Law, refer to Daflon et al., 2013.

[45]Instituto Brasileiro de Geografia e Estatística - IBGE. This is a public institution that provides data to inform, compare and direct positive action.

in the city of Rio de Janeiro for the year 2017, about 38% of the students were two or more grade levels below their appropriate one[46].

To interpret such data, we need to understand how these results are organically constituted. In a complex scenario such as the city of Rio de Janeiro, we can definitely refer to poverty, curriculum, and teaching conditions as three main areas contributing to this situation.

The concept and the real condition of *poverty* are usually associated with prejudice, discrimination, and exclusion. When we combine this situation with an inefficient school system, the consequences are devastating, as this undermines any possible change of status that good schooling could provide.

According to Freitas (2007), when poverty is considered as an external issue, an existing condition generated outside school, which should be approached and resolved from the outside, it is then disregarded during the organization of pedagogical work and the planning of the curriculum. There is a structural blindness towards public services concerning these segregated groups, which leads to the implementation of ineffective practices, resulting in very different school paths for different groups.

The idea that schools are impartial also corroborates the liberal principle of meritocracy, which relates good results with a student's personal effort (Duarte, 2013a). However, Dubet (2004) affirms that the school is just a small part in the success equation for disadvantaged students; a phenomenon already denounced by Bourdieu and Passeron (1992) many decades ago. These authors said that, unless society recognizes that schools are designed to reproduce the capitalist system, there will be no way out to reverse the poverty cycle that the system helps to create and perpetuate. The LDBEN 96 law defines the "cost per student"[47] as the minimum needed, per student, for the necessary resources to guarantee development and quality of teaching and learning, and it also says that such an amount must consider differences between regions and educating systems, as well as the cost of resources. Well, if we can be wholehearted enough to open our eyes

[46]https://www.qedu.org.br/estado/119-rio-de-janeiro/distorcao-idade-serie?dependence=3&localization=0&stageId=initial_years&year=2017

[47]At: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=5368-pceb008-10&category_slug=maio-2010-pdf&Itemid=30192http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=5368-pceb008-10&category_slug=maio-2010-pdf&Itemid=30192 (page 17).

to the undeniable discrepancies existing at public schools, we can then accept that equity is very different from equality (Canclini, 2015; Dubet, 2004; Espinoza, 2007), and also that school is indeed responsible for including, understanding, and considering disadvantaged groups when thinking about curriculum and planning instruction. In this sense, it can be expected that schools serving mostly disadvantaged students in an "at-risk" area, would receive more financial and pedagogical resources, which does not happen.

In addition, there is the issue of the curriculum enacted in schools and teaching conditions.

Regarding the curriculum, in 2017 the *Base Nacional Comum Curricular - BNCC* (Brazil, 1988, 2017) was approved, which is a national framework of curriculum guidelines. It follows principles and intentions predefined in the 1988 Brazilian constitution. The idea is to set central parameters to guarantee that all Brazilians achieve the minimum and common curricular standards. The BNCC defends equality and equity and advocates that, through flexible standards, schools can improve teaching and learning, since they will have the freedom to offer different courses, according to their specific demands, target audience, resources, and peculiar context. However, there is some debate about BNCC's true efficacy and fairness. A flexible and general curriculum framework opens up the opportunity for considering students' reality, in order to implement ICT projects, to offer original, different, and appealing courses to students if, and only if, there is a change in the school curriculum aligned with that purpose (Moreira, 2001; Pacheco, 2016; Young, 2013). Besides, there are always problems with teacher training and paradigm transformation aimed at stopping the cycle of reproducing old practices that disregard social demands, diversity, and economic constraints.

Instead of informing challenges based on the *Prova Brasil*[48], thereby highlighting trends and areas for improvement, the IDEB index ends up being used to pressure schools, teachers, and administrators. In fact, it is a common practice to use average data to determine public policies when dealing with heterogeneous groups, which is misleading. This pressure also favors and feeds

[48]*Prova Brasil* is a nationwide standard exam for primary schools focused on the assessment of Portuguese and Mathematics learning. Find more information on the official site: http://portal.mec.gov.br/prova-brasil

the offering of differentiated paths to diverse students, mainly based on their income and social condition, as already mentioned above (Duarte, 2013a, Duarte 2013b). When using the IDEB index, for example, its average does not expose the fundamental differences in the population. An improvement in the data could, for example, inform the performance improvement of only the most advantaged group. By increasing the overall level, it actually hides the poor performance of the disadvantaged ones.

Freitas (2007) reminds us that poverty is correlated to IDEB levels; invisibility, discrimination and prejudice triggering exclusion mechanisms, such as grade retention, age/grade distortions, and a different "school itinerary[49]". This relationship is clearly found when we compare the level of public schools by neighborhood with their Social Development Index (IDS) (Cavallieri, 2008). When taking a careful look, we find that poor schooling coincides with places with social and economic vulnerability. IDS by neighborhood indeed correlates to the level of IDEB in schools, and lower IDSs and IDEBs are usually found in the area of *favelas*. Some of the lowest IDSs in the city of Rio de Janeiro are from *favelas* in the south and central areas of the City (Rocinha, Cidade de Deus, Maré, Complexo do Alemão), and the five best neighborhoods (highest IDEBs) are in the south zone (Lagoa, Leblon, Ipanema, Humaitá and Urca)[50].

Lastly, teachers are the ultimate agents of teaching. They are expected to be the ones to include and motivate students, differentiate instruction, be creative, use technology, and guarantee meaningful learning. However, there is plenty of data (Goldemberg, 1993; Souza et al. 2017) that reports unacceptable physical infrastructure, crowded classrooms, lack of specific training to teach higher level subjects and implement technology in practice, unreasonable accountability from external test results, and a system that does not encourage pedagogical experience, intellectual reflection, collaboration, and open discussion about teaching goals and professional beliefs. In fact, not much can be done if the school does not provide special services, differentiated resources, and materials to minimize poverty effects. Education for all and effective teaching to combat poverty requires an end

[49]Courses chosen and attended by specific students during basic education years, as well as the enrollment or not in differentiated higher level courses.

[50]http://portalgeo.rio.rj.gov.br/estudoscariocas/download/2394_%C3%8Dndice%20de%20Desenvolvimento%20Social_IDS.pdf

to this blindness, so that prejudice and discrimination no longer result in the many forms of exclusion (Duarte 2013a; Patto, 1992).

Our study was conducted at public middle schools in Rio de Janeiro. We found no surprises there. The majority of the students in public schools come from a lower social level, the IDEB does not go beyond score 7 (out of 10), the classes sizes are large, and the infrastructure is outdated.

Given that poor people represent the majority in public schools, all challenges need to be addressed considering students' realities. In saying that, full-time schools, multicultural curricula, extra pedagogical services, exposure to culture, the *fundamental* didactics as defined by Candau (2012), and positive discrimination should be part of any public agenda.

1.2. The research question

Despite our focus on the documentation process (discussed in chapter 2), we should clarify that this investigation demands a deeper look into the curriculum. Only when knowing what it entails, its purposes, objectives, and content, would we be more prepared to assert if the documentation being done is, in fact, meaningful and important to develop reflective attitude and achieve the intended quality in teaching and learning. It is important, however, to acknowledge that the curriculum is not a closed system and does not encompass everything. It is organic; an amalgam of social and local realities that influence practice yet with the same goal of evident student learning. With their own reflective practice, teachers continuously build on the curriculum together with other professionals. In this process, it is imperative to consider collaborative practices, the collectivity, respect for differences, the value of students' tacit knowledge, the social environment, and democratic as well as ethnic frameworks.

Hence, the starting point of our investigation is that the documentation genesis defended here can be a faithful and powerful ally to determine, investigate, reveal and implement practices according to predetermined goals and teachers' beliefs.

Gueudet and Trouche (2009a, 2009b, 2009c) have investigated teachers' development through their use of available resources, which have been suffering from a significant impact with the onset of ICT. Actually, these authors

introduced the "documentational approach to didactics" as they analyze how teachers search, investigate, select, produce, modify, and use resources, calling this process documentation genesis.

Ramillard (2005) considers that, for any reform or transformation to occur, there is a need to better understand the relationship between teachers and the curriculum that is used. For the author, *curriculum use* refers to "how individual teachers interact with, draw on, refer to, and are influenced by material resources designed to guide instruction" (p. 212). However, she admits that the curriculum can have different meanings. Moreira and Candau (2007) claim that those many meanings are associated with the distinct conceptions education assumes throughout history and depend on the current hegemonic theoretical framework. Different socio-economic, political and cultural factors such as the content to be taught, the experiences considered valid and meaningful, the pedagogical program, the goals, and the teaching processes, also contribute to the meaning granted to the word *curriculum*. Discussions about curriculum, however, always incorporate discussions about academic knowledge, procedures, and social relations that constitute the teaching and learning environment, the intended transformations based on goals, values, and beliefs, and the ideas of citizenship to be developed. Silva (1999) sustains that considerations about curriculum invariably involve themes such as knowledge, truth, power, and identity.

Despite the historical and contextual issues, there are some meanings for curriculum that seem to transcend "historically situated" considerations. In short, there are a few that are quite self-explanatory, such as: a) *formal* curriculum (when the goals and activities are outlined by school policies or designed in textbooks); b) *intended* curriculum (related to the teachers' goals), and c) *enacted* or *experienced* curriculum (what actually happens in the classroom, which involves a participatory meaning making) (Di Paolo et al., 2010; Gehrke et al., 1992).

Research on the enacted curriculum and the importance of both narrative and contextualization (Connelly and Clandinin, 1986; Cornbleth, 1988; Snyder, Bolin and Zumwalt, 1992) has generally acknowledged the material and cultural artefacts and also the active role that teachers play in the process of enactment; instead of simply assuming that teachers are just someone who transmit or give a lesson.

After her detailed study of the relationship teachers have with curriculum resources (including resources that mediate that relationship), Remillard (2005) presents four models for curriculum use: 1) *Following or Subverting the Text* (the text is something to be followed faithfully; the enacted curriculum expected to match the written one); 2) *Drawing on the Text* (teachers have agency over curriculum; materials are resources to be consulted and used); 3) *Interpretation of Text* (teachers are "meaning makers", they use knowledge and experience to interpret curriculum material); and 4) *Participation with the Text* (focus on teacher-text participatory relationship; it overlaps with the perspective of text interpretation, but here both the teacher and the text are seen as active participants). The latter perspective is based on Vygotsky's concept of mediation (Cole, 1996; Vygotsky, 1980; Wertsch, 1995); in this case, teachers learn, adapt, reorganize, change, and are changed as they engage with curricular resources and with the system[51] (Davenport, 2000; Remillard, 1999; Setton, 2002; Van Zoest and Bohl, 2005).

Remillard (2005) suggests that *intended* and *enacted* curriculum are two different things, as well as different ways for teachers to use the curriculum. If school knowledge and what happens inside classrooms are key to making any legitimate consideration about curriculum, documentation work can expose what is realized in the many different contexts. Documentation (its genesis, the process of construction, the work, and the dynamic and ever-changing result) can enlighten differences and help look for common ground. Interaction between teacher and curriculum, mediation with resources, approximation between intended and enacted curriculum, and acknowledgment of context as well as the circumstances in which the teaching occurs, are aligned with the structure and the motivation behind documenting one's own practices.

We also value Temporelli's (2016) work on conceptual change. He defends different methods, techniques, and practices in order to acquire knowledge. The author affirms that, despite the lack of a single, "right" procedure, a different ways open our minds to other possibilities. He is concerned with the complementarity

[51]Despite the lack of reference in Ramillard's work (2005), our understanding is that this perspective suggests material engagement activity. For more on Material Engagement Theory, refer to Malafouris (2016).

between implicit and explicit representations of knowledge and also how analytic and intuitive thinking are correlated.

Curriculum is a project for education in its broad sense. Its importance is revealed by how knowledge is selected, organized and transformed (Macedo, 2016). Documentation comes to play precisely this role; the genesis of documentation appears as this instrument: one that shows and helps us unveil not only the discrepancies between what we believe and know, and what we really do with students and discover along the way, but also how our practices are, most of the time, very different from each other. Documentation built on critical reflection can inform us about the gap between intentions and results and point to how to improve practices, relations, and achievements.

Our object of study goes beyond documentation as a process to register, express and disclose curriculum features and elements. It seeks to connect documentation with meaningful professional reflection, and also considers digital technology in all spheres. It is fundamental to consider Information and Communication Technologies (ICT) in the whole pedagogical process based not only on the amount of time and public investment being spent in teacher training and infrastructure in schools, but also on the undeniable changes in all social processes that digital media engenders. Technology creates new resources, models new forms of mediation and introduces and fosters new learning processes at the very least. Documentation, when constituted digitally, can also help us to deal with the informational blindness caused by the multitude of available data. Digital resources have brought evolution to documentation systems and professional practices. (Gueudet and Trouche, 2012)

Based on the considerations about curriculum and teacher's practices, our research question is stated as: **In which ways does teachers' documentation work relate to reflection?** The proposed investigation is configured as follows: if the "teacher" is of fundamental importance for "thinking about" and "acting on" students' developmental process, their capacities and abilities, then it is paramount that we investigate and understand better what that professional does (the practice) and how he/she thinks about the learning process, knowledge development, his/her motivations, beliefs, and objectives. This idea made us search for shreds of evidence on reflective practice into teachers' documentation

processes[52]. The objective of this study is, during the investigation of documentation work, to try to find a connection between certain theoretical perspectives:

- higher level critical thinking and *double-loop learning* process leading to transformation by Argyris and Schön (1973), Maddux and Johnson (2006), Temporelli (2016), Sovacool and Hess (2017), and Sterling (2010);
- reflective teacher by Shön (1983, 1995, 1995b);
- instrumentalization by Rabardel (1995), and Rabardel and Samurcay (2001);
- documental genesis by Gueudet and Trouche (2009a, 2009b, 2009c, 2012), and Gueudet et al. (2012, 2013);
- pedagogical use of ICT by Engestrom (2008), and Hill and Hannafin (2001).

In order to accomplish this and answer our research question, we will ground our investigation in some important concepts which will be explained in more depth in chapter 3. For now, in the following chapter 2 we will present both literature review and the conceptualization of documentation work to be used in our investigation.

[52]The evidence can be understood as what Shulman called Pedagogical Content Knowledge, the specific knowledge that reflects the expertise of the teachers as he/she models, modifies, adapts the content to his/her pedagogical reality (Shulman, 1986, 1987).

2
BACKGROUND

"The undertaken of a new action brings new strengths."

Richard L. Evans

2.1.
Literature Review

Despite our theoretical framework mainly grounded on international authors, because our field of study is public education in Brazil (more specifically, in the City of Rio de Janeiro) and our data was collected locally, the literature review focuses on Brazilian databases.

The investigated bibliography did not register a representative amount of research related to **middle school teaching and digital documentation work**, or the **documentation process and reflective practice**.

We searched in the six main research portals: *Integrated Research* from PUC University (Rio de Janeiro), *Dissertations Database* from São Carlos University (São Paulo), *Digital Library* from the University of São Paulo (USP), *Scielo Database*, *Google Scholar*, and *CAPES Dissertation and Journal Databases*, a government portal of the Ministry of Education. In all of them, we used the "advanced" option to narrow down our results. We limited the time period to at least 10 years (2008-2018), but no more than 12 years (2006-2018), depending on the portal used and the options offered for the search. We also set some constraints based on our keywords. In some cases, such as when searching using Google Scholar, we had to avoid some words, as they guided us to different fields of study (for example, medical studies, archiving processes, and dentistry).

All together, the search returned 509 results (research papers, articles, academic material, dissertations, etc.) that had the keywords selected (see appendix 2). However, as expected, because the searches were independent, there was some duplicity, meaning that the total of original related documents could be fewer than 509.

Of these 509 findings, only 25[53] can be considered related to the main theme, whilst none were found for the "digital documentation" parameter meaning "pedagogical digital documentation". For this reason, we can affirm that, within the verified academic production, there was no pertinent amount of research investigating teacher documentation at the middle school level, using digital media as a potential instrument to help reflection practice.

As mentioned before, we can argue that documentation is being addressed, at least in the national academic literature, under the concept of "portfolio". For that reason, we also searched for work related to the subject of "digital portfolio". As this was shown to be a more common term in Brazilian literature, we had to use even more constraints. When blocking words such as *nursery school*, *arts*, *heritage*, and *archival*, for example, we did not find much to be investigated as potential output on the field.

In addition, despite some mentions of the reflective dimensions of portfolios, the majority of the work found highlighted the portfolio's evaluation properties, such as diversity of methods applied, innovative practices, holistic view, efficiency and authenticity (Martins, 2016). For example, when analyzing definitions of "portfolio" used by 7 different authors, out of 275 studies, only 117 referred to the critical dimension of reflection. Martins (2016) did an extensive investigation into the origin of the word *portfolio* and its uses. She states that there is no logical relationship between facts and words, but that their understanding occurs through the practices in which the words are used.

The existing (national and international) literature related to our theme is divided into three main areas: a) teacher documentation (Espinola, 2016; Gueudet et al., 2009, 2013; Lim, 2016; Neuenfeldt et al. 2014; Peaslee et al. 2007), b) professional engagements (that of teachers, more specifically) with digital technologies and their constitution as cognitive instruments (Bittar, 2011; Cole and Engeström, 1993; Heersmink, 2016; Hill and Hannafin, 2001; Salomon, 1993), and c) reflection as a means to improve practice (Borko at al., 1997; Hasseler and Collins, 1993; Jay and Johnson, 2000; Shön, 1996; Zeichner, 1987, 1992, 2008).

[53]All references of the related material found and investigated are in Appendix 2.

Based on our search, we found relevant work that focused on teacher documentation (mainly referred to as teacher portfolios), fewer studies that focused on professional interactions such as the establishment of communities of practice, and even fewer that discussed the critical reflective aspect.

One point of interest is the occurrence of investigations on teacher practice as a locus for creative production based on action. This knowledge is usually referred to as *expertise*. Authors such as Tardiff (2000) and Shulman (1992) recognize the importance of knowledge generated during practice. Bona[54] (2013) says that documentation can uncover this knowledge and also disclose the strategies available and used during such a process. Andrade Filho (2011) states that when we contemplate teachers' expertise, we fight against technical rationality, which is very common in pedagogical practices; we give the opportunity for new approaches, thereby validating differentiation, creativity, and innovations.

Another related finding is exemplified in the work of Palma (2010) and Teixeira and Matos (2017), who claim that a portfolio is used to "create meaning", highlighting the relevance of Activity Theory[55] on the process, as an explanatory framework.

The literature review pointed to a gap in the research developed since 2008. Themes such as teaching documentation, reflection on action, collaboration, and interaction with digital technology have attracted attention, energy and time from academia; yet, with the restraints used in our search, we did not find studies that tried to tackle these four aspects as part of the same pedagogical process or any work that mentioned extended and distributed cognition under these pedagogical processes. It seems to us, however, that it makes sense to investigate the four of them in a dynamic and integrated manner. At schools, teaching practice is dynamic, intense and happens far from peers' eyes. For that reason, the documentation that starts before practice continues afterward, and embraces not only evidence of learning, but also planning, communication, and reflection is genuinely important to allow that the processes become visual, and, as a consequence, able to be revised, criticized, and shared. Moreover, when

[54]In her work she used the word portfolio and not documentation. We mention her, understanding that the aspect of displaying teachers' practices, teachers' motivations, and constructed knowledge is similar in both those instruments, if not the same.

[55]As defined in Vigotsky (1930), Leontiev (1978, 1981), and Engestrom (2000, 2001, 2008).

documentation is produced digitally, it becomes easy to share and remix through space and time. Digital documentation favors the implementation of new practices, expands the definition of pedagogical resources, extends our cognition and allows new products and processes.

We try here not only to advocate for the importance of pedagogical documentation as an interconnected and multifaceted process, but also to find evidence that such documentation improves teaching practice[56].

2.1.1. Related findings from the literature review[57]

Based on the review, **we observed that no work featured digital technology as an instrument for the documentation of a pedagogical process at the middle school level**. Much research was directed at medical fields such as dentistry, nursing, occupational therapy, and orthopedics. Another important group focused on "digital", as in "digital records", such as pictures and videos. This last group dealt with ways to make registrations and processes more reliable, durable, and fast, attending to "customers". This is the case of digital documentation at libraries, and at public departments, both related to quality management. Yet others mentioned digital documentation referring to a series of digital pictures, for example, to control degradation of art or historical buildings.

One work that drew our attention was an investigation on teaching practices in Math classes called *Uma investigação sobre a prática pedagógica: refletindo sobre a investigação nas aulas de matemática*[58] (Abreu, 2008); this research looked into public and private schools in the State of São Paulo (Brazil) and gathered documentation done by students and teachers (for example, written records) to explore: a) the guidance/interaction performed by the teacher, b) the students' acquired autonomy, and c) the Mathematics class as an epistemological place of knowledge production. The results pointed to the importance of teacher's

[56]We will consider good teacher practice here as that accounting for/relying on/ making use of formative assessments, collaboration among peer colleagues, alternative teaching strategies, diverse resources, diverse learning profiles, metacognitive activities, sense and sensibility to choose content and discourse, among others.

[57]See Appendix 3 for secondary bibliography based on the literature review. These works were analysed for relevant information, for refinement of concepts used here, and to illustrate the many uses of documentation in other professional fields.

[58]An investigation about teaching practice: reflecting about investigation in a math class.

research on his/her own practice, looking inside his/her own world, and reflecting on and reviewing the already acquired knowledge, converting it into new knowledge and inspiring future practices (Abreu, 2008).

When we searched for the keyword, "*documentação digital*" (digital documentation)[59], most of the research found concerned lower school education. Documentation on young children's teaching and learning processes is usually influenced by practices from the Reggio Emilia[60] region (located in central Italy), where teachers document the work done with students who mostly did not master verbal communication skills yet, with the objective to give "voice" to the young children, to make the learning process visible, and to record, communicate, and analyze their universe, their abilities, potentialities, and difficulties. This documentation can influence future practices, but it is not designed to be shared, reutilized, reformulated, or to deliberately contemplate digital products, but rather to foster personal reflection and to ensure that children are seen and treated in their wholeness and not as human beings "in transition", being prepared for their adult life.

When reviewing literature about teaching documentation and reflection on three main portals[61], 4 out of 7 studies were about Pre-K schooling and nursery. They all had in common the conception of documentation as a process involving observation, records, and reflection; one that can lead to conceptual changes; documentation has an epistemic function: when a teacher seeks ways to document and record practices, he/she has his/her own representations changed (Gontijo, 2011). In addition, documentation has communicative and formative dimensions, as it gives visibility to events and processes, besides informing other teachers about past practices, and new perspectives. Besides, documentation is also a social practice; it entails social (situated) conditions in which learning occurs and includes other agents involved in the pedagogical process.

As we were able to verify, many studies on pedagogical documentation concern children's education in their early years; however, we can use some of their assumptions and premises to enlighten and inspire our study as no classroom

[59]Portals: PUC/RJ University at http://www.dbd.puc-rio.br/sitenovo/ and UFSCar University at https://repositorio.ufscar.br/

[60]For a better and deeper understanding of the pedagogical practice done in the Reggio Emilia region, see Rinaldi (2006).

[61]PUC/RJ, SCIELO, and Google Scholar (see appendix 2).

is so unique[62] that it does not display some sort of structural stability, and such stability displays certain similarities in teachers' behaviors. As such, despite the lack of research on middle school documentation, and keeping in mind the idiosyncrasies of each group (pre-K and lower school as opposed to middle school), we can still find common ground on objectives, motives, structure, and content of such documents.

After revising these studies mentioned above, we can, however, agree on some basic common and constant topics of interest, motivation, and objective[63]:

- Nowadays, records should emphasize and focus on the immediacy and speed of communication in our digital era, using all the possible digital tools as allies; digital documentation affords instantaneous registrations of diverse phenomena.
- Observation, interpretation, and documentation are important features of pedagogical practice, as, through records, teacher's thinking is materialized, making it tangible and capable of being interpreted.
- A community of practice is very important for the socialization and externalization of developed knowledge.
- Analysis of a teacher's thinking process is a key instrument for understanding his/her conceptions and pedagogical practices and improve related practices.
- Documentation can be understood as an antibody against standardization; it considers and gives attention to the specificities of each teacher's work, the interaction and creation involved in his/her peculiar and situated pedagogical process.
- To document a teacher's practices is a valuable resource for detecting pedagogical processes' quality and quantity so that what is planned and said can be confirmed by the corresponding documentation.
- Documentation is…
- an important instrument for teaching as it outlines a "road map" for action, and not a simple archive for memory and data,
- an instrument to promote debates and to value pedagogical processes; in this sense, it also constitutes an instrument to reflect on and to encourage teachers' productions,
- not to show results, but to seek the humanizing development of the student,
- grounded in a theory; it will only mean action if "change" is part of the intrinsic motivation for documentation genesis,
- historically situated; there is no right or wrong way of doing it. Its genesis allows for creativity, reflection, visibility of pedagogical processes, communication and memory, all the more powerful when taken up by a collectivity,

[62]Concerning students' characteristics (age and level), environment, and school structure, for example.

[63]See Appendix 3 for the reference of the documents analysed.

- a space for ongoing, constant construction, and registration of the refining process,
- not only observation and registration, but also analysis and reflection; it shares views and beliefs and looks to the past to understand the present and improve the future,
- an activity intended to transcend the spontaneity of the pedagogical process, as it entails intentionality and reflection,
- an important aspect for constructing high-quality pedagogical practices as it relates to reflection about practice, to continued learning, to memory and identity, to planning and assessment,
- grounded on Activity Theory; teachers interact with resources with the expectation that they will reflect upon them, being part of a transformation cycle,
- a possibility for new pedagogical methodologies,
- an educational practice with an emancipatory character; it promotes reflection and self-reflection.

We claim, however, that pedagogical documentation will only be considered an activity if its motivation rests on and is committed to a humanization project, one grounded in ethics, respect, and justice.

Based on the literature review, we will respect the subtle and not-so-clear differences between the concepts of documentation and portfolio creation. We will also consider an authentic and legitimate documentation process as one that is grounded in activity theory and results in action, thereby seeking transformation and improvement of learning and well-being in general. Our investigation corroborates the exposed characteristics of documentation as a process that involves observation, records and reflection, one that could lead to conceptual change. It also agrees that documentation has communicative and formative dimensions, being considered a social practice. Following the literature review we now present a more detailed conceptualization of the term documentation work, clarifying at the end of that section, the one to be adopted in our research.

2.2.
Documentation in context

Despite the micro-region where our subjects of study came from (middle school/city of Rio de Janeiro), our investigation deals with a real, existing and promising pedagogical process, flexible enough to be meaningful in any possible context teacher’s documentation work.

2.2.1.
Documentation and the archiving logic

We can assume that pedagogical practices documented by teachers can resemble an archive, as those documents that have common specificities and structures such as the logic and the form of pedagogical processes (planning, activities, etc.). According to Bellotto (2014), such documents are testaments to means, processes, teachers' actions, goals, and motives. He states that they do much more than just inform and describe agents, places, activities, and methods. Eastwood (2010) claims that archives are a social creation because they are a product of an evolving society; throughout their growth and development, the representing features and characteristics from this society are transmitted and reflected in the resulting products, whether cognitive or material. In this regard, we can understand documents and archives as a result of an organic phenomenon that is complex, connected, and active; they influence and are influenced by the reality in which they are constituted; more than just registering, they implement and create meaning.

Similar to the dynamics of archives creation (Bellotto, 2014), documental genesis follows a logical production that is changed and adapted depending on agents and their perceptions, institutions, instruments used, and the norms and rules of the pertaining field; all the motivations and purposes that are involved in the process. In fact, such elements are constituted and actively participate, directly or indirectly, in the documentation work.

The conception of meaningful documents, authentically related to teaching practices, can relate to human action engaged in purposeful behavior (Chevallard, 1999), as the action of documenting the moments of a didactic transposition[64] can help to organize the practice and create meaning as well (Chevallard, 1991). In

[64] "Bodies of knowledge are, with a few exceptions, not designed to be taught, but to be used. To teach a body of knowledge is thus a highly artificial entreprise. The transition from knowledge, regarded as a tool to be put to use, to knowledge, as something to be taught and learnt, is precisely what I have termed the didactic transposition of knowledge.". See "Didactic Transposition Theory: some introductory notes", by Yves Chevallard. Available at http://yves.chevallard.free.fr/spip/spip/IMG/pdf/On_Didactic_Transposition_Theory.pdf

this sense, we can understand the document that reflects pedagogical practice as an ostensive object of *teaching praxeology*[65].

We affirm, therefore, that documents and analysis of pedagogical decisions (Espinola, 2016; Gueudet and Trouche, 2009; Margolinas and Rivière, 2005) are not only pertinent but very important in order to unveil practices and help understand tacit knowledge (Polanyi, 1966) involved in teaching. However, documentation work cannot leave aside a critical bias[66], otherwise it will not be anything but an instrument of narratives (Neuenfeldt et al., 2014).

2.2.2. Documentation and portfolios

As Smith and Tillema (2003) state, there is increasing literature about portfolios being used in a range of contexts, and for a variety of purposes. For example, besides education, we see extensive use in medical schools and nurse training (Silva and Sá-Chaves, 2008). Portfolios are either summative or formative in nature and usually are characterized by a non-mechanical, outcome-oriented collection of evidence about a specific practice. Indeed, the paradigm of technical rationality, characterized by samples that lead to uniformity and reproduction of uncritical and rigid models of professionalism, is no longer sufficient, as it is not able to explain new social relations and organizations based on ICT and on the dynamic, original, and uncertain characteristics of this new context.

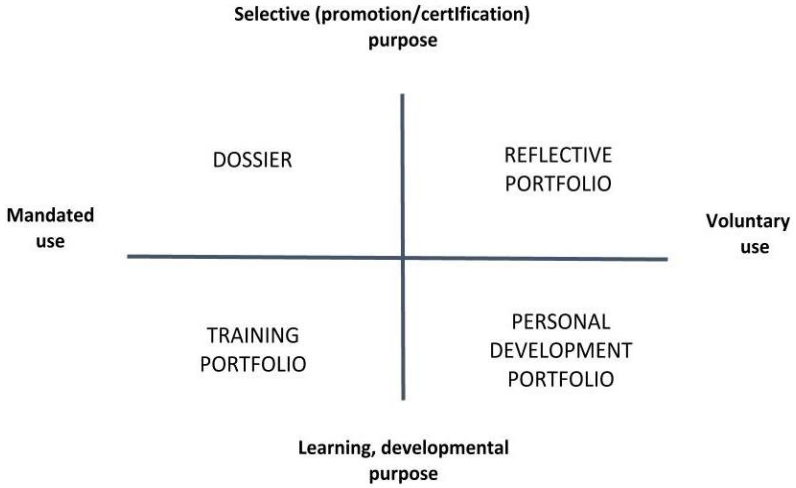
However, despite the appealing idea behind the portfolio's general concept of being a compilation of evidence for evaluating work quality, learning progress, and achievement, there is little consensus about the guidelines for its structure (Wade and Yarbrough, 1996). Even less evident is the relationship between the selection of materials and reflection on the work selected. In addition, we note that, when the portfolio is issued for bureaucratic use, it somehow frustrates the promises of improvement, discovery, development, and achievement that it carries.

[65]Praxeology is a theoretical framework that also works as a tool, which is informed by the theoretical perspective, disclosing teaching intentions. For more on the matter, see Chevallard, 2007.

[66]Deliberations regarding personal beliefs, professional and personal objectives, students' autonomy, social responsibility and others.

In order to clarify the portfolio's specificity, Smith and Tillema (2003) suggest analyzing two dimensions: the *purpose* and the *setting of use*. Purpose refers to whether the practice was directed towards promotion or selection of material, and setting refers to whether the practice was due to voluntary will or external requirements. The authors offer the following diagram (figure 6) to explain the different types of portfolios resulting from various combinations of these two dimensions (Smith and Tillema, 2003, p.628).

Figure 6. Different types of portfolio



Source: Smith and Tillema (2003)

A *dossier* records evidence of achievement mostly for promotional purposes; a *training portfolio* showcases the work done during a curriculum or a training program; a *reflective portfolio* collects pieces of evidence of growth and achievement that reveal best practices, which focuses on promotion or admissions; here, considerations about *why* are important, and the authenticity of the whole process is questioned because its construction is mandatory. Lastly, the *personal development portfolio* is a reflective practice for professional growth; its compilation is an opportunity to discuss the value and meaning of the selection itself, and the sharing and the restructuring processes are important for individual growth.

The difference in motivation behind the construction of portfolios and what is counted as evidence, besides the time frame and the purpose, explain the different outcomes. Despite their differences, they all require dedication and time. Portfolios are a practice that produce information to make valid inferences about

phenomena. However, they can only serve their purpose if they are explicit about their means and trustworthy regarding the material collected (Smith and Tillema, 2003).

In this sense, we might say that, although we understand portfolio and documentation work as two different processes, one might find their use representing similar actions. In fact, words take on their meaning when used in language. Portela and Portela (2010) refer to Wittgenstein when they affirm that *languages* and not *language* exist, a multitude of uses, and multiple functions or roles; which are identified as language games and have "family resemblance".

We find many meanings for the word portfolio, varying from arts, archival practice, product management, and many others in medical practice. Also, considering education only, we can identify many uses such as for the evaluation process, evidence of students' work, evaluation of university-level professors' performance, and as a curriculum vitae (Marins, 2016). Other authors have also investigated portfolios in their different aspects, such as "for reflection" (Sá-Chaves, 2004), "for learning" (Zeichner, 2008), and also as a digital tool/resource (Barrett, 2007; Heath, 2005).

Despite its frequent relationship with the evaluation of a sample of work selected as a representation of evidence of learning, we cannot deny its many different meanings and applications, as already mentioned in the work of Smith and Tillema (2003) and corroborated by Marcolino and Mizukami (2008). In their study about reflective processes, these authors investigated occupational therapy sessions and detailed 4 main ways of registering and documenting practices:

a) *descriptive narrative*: records events without detailed reasoning behind the actions, discloses agents involved and their motivations;
b) *reflective description*: seeks justifications for actions, recognizes different points of view based on personal perspectives or on external recognition;
c) *dialogic reflection*: performs personal self-discourse; it is a recollection of facts using different narratives to raise and justify hypothesis; it is centered on personal judgment and relies on past experiences;
d) *critical reflection*: acknowledges that actions are not only due to and influenced by different perspectives, but they are mainly a result of different social, historical, political and cultural contexts.

Based on the above classification and explanation concerning portfolio definition and related characteristics, we might ask what the difference between portfolio practice and teacher documentation work is. One might refer to a portfolio as more of a personal journey (collection of artwork, evidence of students' learning), whereas documentation focuses on self-analysis, together with a concern about improvement, sharing knowledge, and a broader perspective that is usually connected to transformation. Other researchers identify portfolio with a students' perspective, a short/middle-term project (or a long course) to record and display evidence of learning, whereas documentation characterizes a professional, ongoing practice, always focused on records of all dimensions of a pedagogical project, susceptible to verification, analysis, modification, reuse, criticism, and adaptation to many diverse contexts (find more information about documents and their structure below). Still others have highlighted that the different aspects of portfolios are due to their different purposes and motivations.

We can definitely find a relationship between what we will define and investigate as *critical documentation* and *critical reflection*[67], as defined in the work of Zeichner and Liston (1990), Hatton and Smith (1995) and Marcolino and Mizukami (2008). It also see similarities with a combination of *reflective* and *personal development portfolios* as defined in Smith and Tillema (2003). For our study, we will try to pair the concept of critical, personal *portfolio* (in our case, virtual) with the one resulting from teacher *documentation* work.

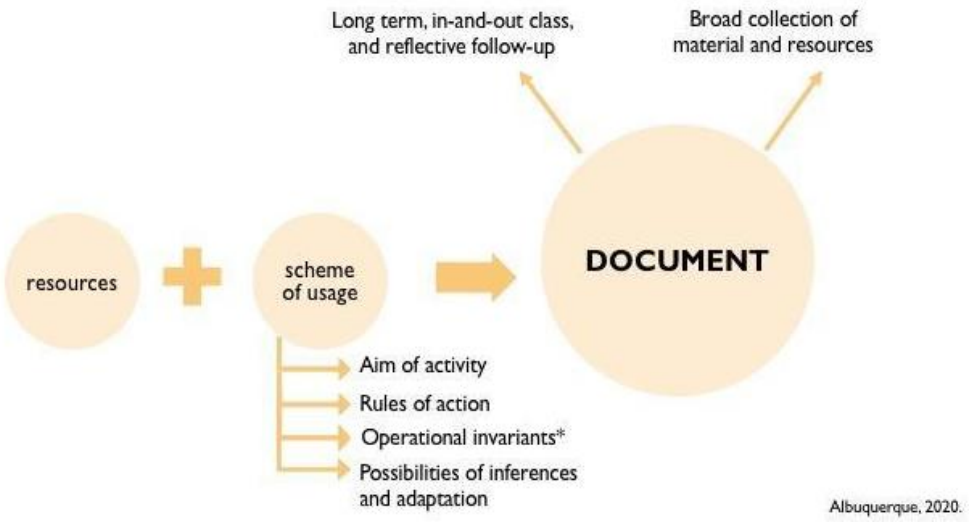
Here we will adopt Trouche et al.'s (2018) perspective about what a document is. The authors define a *document* as the outcome when resources are combined with their schemes of usage, through mediation. In other words, it is a record (in this case, made by teachers) of processes or outcomes accompanied by comments, rubrics, and examples, involving technical and conceptual aspects. In this sense, this work will refer to the *document*, resulting from documentation genesis, as a product that entails not only records of practices, evidence of learning and samples of materials, but also material, social and cognitive

[67]"Critical reflection implies an acceptance of a particular ideology along with its assumptions and epistemology." (Zeichner and Liston, 1990). "It calls for considerations involving moral and ethical criteria, making judgements about whether professional activity is equitable, just, and respectful of persons or not. In addition, critical reflection locates any analysis of personal action within wider socio-historical and politico-cultural contexts." (Hatton and Smith, 1995).

resources, such as textbooks, web forums, frameworks and theoretical tools (Pepin and Gueudet, 2018).

Figure 7 represents the components of a document. Resources are typically curricular, such as textbooks, guidelines, worksheets, students work; or digital, such as interactive textbooks, pictures, videos, sounds, etc. However, in his work, Trouche (2018) considers Adler's (2000) proposition of using *resource* as "source again or differently" (p. 207). In that sense, resources here will be considered as a wider spectrum of elements that have the potential to "resource" teachers' activity, in other words, anything that assists their engagement in teaching and also their commitment to best practices.

Figure 7. Structure of a document



*knowledge components [68]

Source: adapted from Trouche (2018).

The scheme of usage is linked to a range of situations, which, in our case, is the context in which the teacher engages in his/her practice. Trouche (2018) breaks down this scheme in four components: a) the *aim of the activity*, which is characterized by a class of situations (specific class of students, with a specific target audience, in a specific institution; for example, a unit about rational

[68] In his work, Vergnaud (1998) distinguishes two different kinds of **operational invariants**: concepts-in-action and theorems-in-action. He defines a concept-in-action as "an object, a predicate, or a category which is held to be relevant," and a theorem-in-action as "a proposition which is held to be true" (Vergnaud 1998, p. 168). His definition is also used by Trouche (2018 p.4)

numbers for 6th graders), b) the *rules of action*, which is how to retrieve the information and to control the practice being put into effect and also the mediation performed, c) *operational invariants*, which are the propositions being accessed and concepts considered relevant (for example, teacher's beliefs that "students learn better when working in pairs", or that "short movies are good to be used when introducing a new social studies concept"), and d) the many *possibilities* for inferences, changes, and adaptations to the diverse, unpredicted situations.

The document then will use and produce a broad collection of material resources and will have its schemes defined after a long period of follow-ups, not only the ones occurring in school but also the ones originating at home as well as at centers for instructional training.

For this work, we will use Trouche's (2018) definition for document but we will *expand* his view when concerning schemes of usage. We affirm that sentiments, emotions, ones' bodies and physiological constraints actively participate in the definition, development, and adoption of such schemes. Bannell (2019) says that aesthetic sensibility is a relevant aspect for knowledge building as well as for thinking (p.3). Regarding perception and interaction, Dewey explains that:

> "Feeling" is in general a name for the newly actualized quality acquired by events previously occurring upon physical level, when these events come into more extensive and delicate relationships of interaction. (Dewey 1934, p.267)

Regarding perception and knowledge development, Dewey (1934) then adds that perception is intermittent and discrete, involving a continuum of meaning in the process of formation (p.308); when we try to ascribe qualities to events through the medium of living things they generate effects and consequences, thus qualities become intelligible and knowable (p.269). Indeed, teachers who value the development of critical reasoning should be using resources that truly foster such performance by students.

In light of the foregoing, we will grant "documentation" the possibility of establishing a responsible, participative and active educational process[69], and the capacity of using many languages to promote interactions and learning.

[69]Processes are groups of actions that evolve in time. Our investigation here is not longitudinal, but rather confined to a specific point in time. During our investigation, we observed and analyzed

Based on the work of Smith and Tillema (2003), we understand that experienced teachers have a better chance of voluntarily perceiving the advantages of such a practice. Based on their study, we can say that their control group (experienced teachers, familiar with a portfolio process) expressed epistemological curiosity and were open to adaptations, transformations, and also self-reflection. They raised their awareness about the construction of knowledge that came from practice and showed self-confidence during their documentation process.

Documentation entails how a curriculum was understood and performed in practice. According to Perrenoud (2008), it enables the transposition of knowledge to the domain of action, in this case, reflection about grounded and authentic work. A document, as we will consider it here, should then have an ecological approach, under which long-term follow-ups guarantee interaction between teachers practices, students' work, and stakeholders' expectation, an interaction that proves to be effective, cultural, profound, social, communicative, transformative and critical.

2.2.3. Documentation as a pedagogical tool

Gueudet and Trouche (2010) utilize the concept of documentation genesis, founded on instrumental genesis, by Rabardel (1995), and defend its use in education as a means to improve practice. They believe that when teachers document, they reflect upon their own practice as they are undeniably attached to a metacognition process; in order to document, the individual stops, thinks about what has been done and how it happened, and, during the documentation, they review their own practice. Goody (1981) emphasizes the importance of writing to create content, but most of all, to communicate. He claims that, while writing, there is a change in the thinking process causing a resignification and a transformation of the content, as logical reasoning is applied to abstract ideas through metacognition and reflection. Writing also has the power to transmit at the same time as it preserves what has been created; if writing is manifested in

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teachers' perceptions about their documentation work and some evidence of such work. However, as we examined the content of their discourse, we can suggest that their documentation work is part of a process that did not start at that point nor would ends just after it.

digital documents, the reach of its content transcends time and space. In this regard, there is also materiality in the thinking process, as the resulting document embeds the processes involved in its constitution.

Porlán and Martín (1997) also emphasize documentation practice and defend that it allows for teacher reflection on his/her evolution process in order to happen: reflection about their own references, conceptions, ideology, and epistemological beliefs, about human development, about learning and social relations, about content and so forth. In addition, they suggest that benchmarks are manifested during professional activities such as drawing up the curriculum, selection of materials, and assessment. When documenting, there is usually an attempt at representing the expected reality through interaction with goals, intentions, and students' perspectives, all in a complex, ever-changing and problematic context (Porlán and Martín, 1997); more than representing reality, documentation work in fact holds the power to change it. Documentation practice can help explain and question beliefs and implicit theories, outline potential action to resolve issues under new perspectives, experiment with new strategies, and evaluate their effects; in other words, documentation can assist the progressive development and improvement of teaching capacities. Likewise, Zabalza (2004) also endorses documentation work integrated into a circular model for teaching quality that incorporates planning, doing, documenting, analyzing, and re-planning. Whenever teachers are engaged in and thinking about their own practice, they are no longer compliant with predetermined rules as mere executors of tasks, but as active researchers of teaching practice. In fact, it is in schools that the teaching training process is consolidated. Documenting pedagogical actions reveals a myriad of contexts contemplated in teaching practices, which favors, among other things, knowledge building[70].

2.2.4.
Documentation to contemplate the "didactic scene"

Here we will refer to *didactic scene* as the moment in which there is the elaboration of teacher planning, for example, planning a class. However, the

[70]In the sense defined by Shulman (1986) – Pedagogical Content Knowledge.

giving of class (using the example cited above) is determined not only by a process that started before it, but also by what happens afterwards.

According to Margolinas (1995)[71], when a teacher enters a classroom, he or she becomes a constitutive part of what Brousseau (1986a) calls a "didactic phenomena", as this teacher becomes an active part in a complex system, composed by the interaction of many other systems which have their own physical aspects: students, norms, institutional rules, and other stakeholders' beliefs, whether they are more or less participative in this process.

Margolinas and Riviére (2005) defend that a teacher arises from the present situation in which he or she is, based on the available resources and emerging challenges. During that specific moment, the teacher will pursue a balance between his/her practice and the environment in which it takes place.

On that note, Laurillard (2007) affirms that a teacher should be prepared not only to teach a previously planned class, but also to interact with the students, respond and react to their answers and concerns, and also evaluate the results of the actions taken. Interaction is, in fact, one of the basic and core concepts of complexity theory, through which we can observe the classroom setting as well (Pischetola and Miranda, 2019).

The planning of a class happens before this class is given; and the results will drive evaluations and modifications afterwards. Therefore, we can understand a didactic scene as the culminating point of teaching activity that expands over time.

The chronogenesis of a didactic scene

In accordance with Laurillard (2007, see section above), who recognizes pedagogical action *before* the didactic scene, Margolinas and Rivière (2005) highlight that a teacher also acts *after* the scene; for these authors, the concept of a teaching process should necessarily contemplate a reflective[72] moment, likely to foster changes in practices focusing on learning improvement. The three authors agree on the timing issue related to teaching practice. Chevallard (1985) uses the term chronogenesis to better explain the temporal but connected aspect of a

[71]Also see Margolinas (2002), Margolinas and Riviére (2005), and Margolinas, Coulange and Bessot (2005).

[72]More on reflection and critical reflection in section 3.2.1.

didactic scene (Margolinas, 2002). Representing the teaching process in steps facilitates the comprehension of the culminating moment that we are calling didactic scene.

Aspects of a didactic scene

Develay (1995) recognizes important constitutive aspects of a didactic scene. For example, he mentions choosing the concepts to be addressed, the structure where the scene will happen, and the teaching methodology as key parts for any goal achievement.

Chevallard (2007) and Remillard (2009) acknowledge the sensitive and significant moments assisting in class planning and its actual implementation[73]. Yet Margolinas and Rivière (2005) are more assertive when establishing moments (different levels) to exemplify this time span. The scheme presented in figure 7 can be understood either from the student's or the teacher's perspective.

Levels -3, -2, -1 happen before the didactic scene (in our case, a class); the objectives are narrowed down and the actions are more detailed.

Level 0 is when the planned scene takes place (the class).

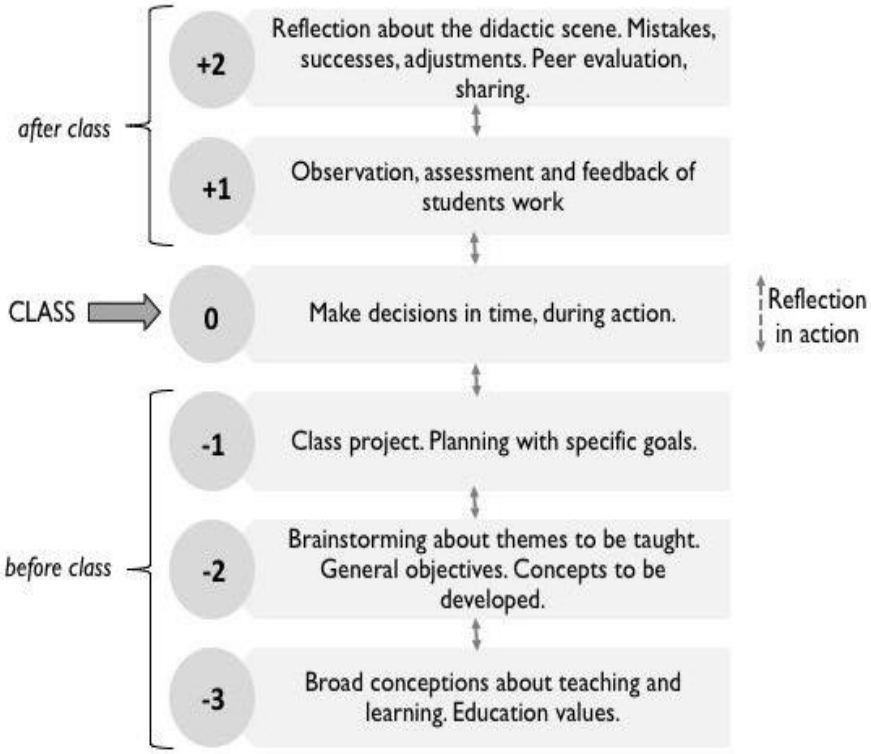
Levels +1 and +2 result from the scene; they are constituted after the teaching practice.

We would like to reinforce that level +2 corresponds to a reflection moment, one which Schön (1983) relates to improvement of practice (reflection about the reflection on action). Our study investigates a possible relationship between such level of the pedagogical process and the teacher documentation work. However, we would like to reinforce that we believe that teacher's practice involves reflective attitudes throughout the didactic scene[74]; for example, we can relate Schon's reflection in action (1983) to the Level 0 described above.

[73]For more about didactic transposition, refer to Chevallard, 1991.

[74]More on reflection and critical reflection in section 3.2.1.

Figure 8. Pedagogical process of a didactic scene



Source: adapted and translated by the author
(Margolinas, 2002, and Margolinas and Rivière, 2005).

Didactic scene and the documentation process

Margolinas and Rivière (2005) defend that the process involving a didactic scene is epistemologically constructive. This knowledge is referred to as "experience". Shulman (1986)[75] also mentions the multiple different sets of knowledge that any teacher accesses during his/her practice; he adds that the dynamics between them is paramount for the development of what he calls an outstanding teacher.

Thus, based on the comprehension that a pedagogical situation involves many levels that interact with, determine and influence one another, it is desired that all levels be considered, not only in any research about teaching practices, but particularly in this work, which levels ought to be considered when investigating teacher documentation work (TDW).

During the didactic situation, a teacher revisits, exposes, develops his/her pedagogical knowledge, his/her content knowledge and also his/her pedagogical content knowledge (Shulman, 1986). The teacher is physically and mentally

[75]See also Ball, Thames and Phelps (2008).

engaged on the process. Documental genesis should contemplate all these many sets of knowledge as well as their history, the way a pedagogical unit was planned, the basic and necessary elements for efficient action during a learning process, and also reflection done before, in, and after a class.

Our hypothesis is that documentation resulting from such a pedagogical process would most likely be able to register the "wisdom of practice" (Shulman, 1986), resulting in a virtuous circle of student learning and teacher education.

2.2.5. Documentation as an instrument of reflection

Gueudet and Trouche (2009a, 2009b) affirm that documentation is more than just collection and identification of used resources. It also includes modifications, adaptations, and critical revision of the whole process. According to the authors, these characteristics validate documentation as a "reflection instrument". Schön (1983, 1993, 1995) also affirms that reflective processes are powerful factors for improving practices in general, and teaching practices more specifically. He recognizes that reflection leads to knowledge development. One example involves the expression of tacit knowledge[76] by students; usually, when a teacher is intrigued with such a situation during his/her teaching, he/she reflects, questions him/herself, reformulates problems, and tests a new hypothesis, reconsidering his/her own practice.

Gontijo (2011) defends a similar point of view when he says that the benefits of documentation for the improvement of practice transcend the generation of bureaucratic records commanded by institutions; documentation involves observation, it has a communicative dimension, it is a powerful instrument for research, and it is also a social practice and a way to investigate teachers' thinking. Documentation is a sequence of moments.

Porlán and Martín (1997) endow the continuous practice of documentation with the ability to investigate and reflect upon one's own professional practice, as documentation is, first and foremost, a biographic testimony of practice. Such documents should be considered as a flexible guide that allows retrieval and revision of what has already been tried and done.

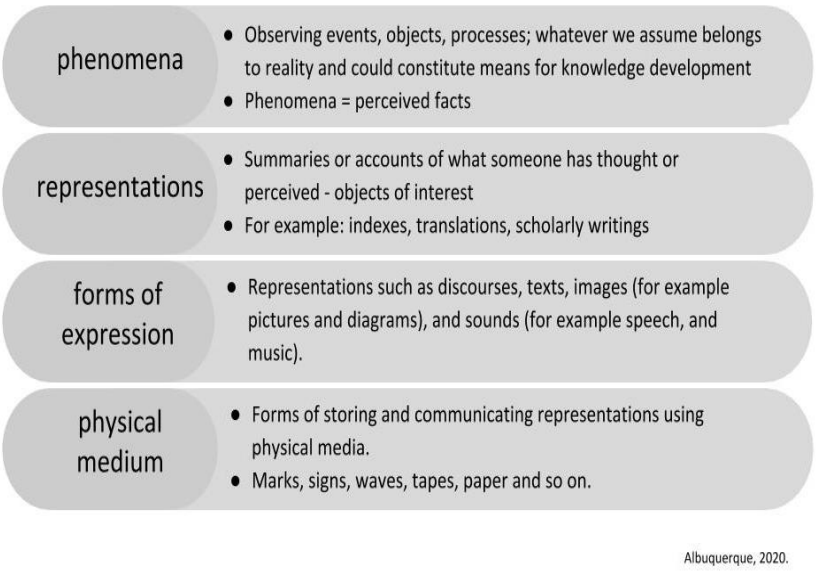
[76] As defined by Polanyi (Polanyi, 1966, p.4-7), and Cardoso and Cardoso (2007).

2.2.6.
Documentation as a digital instrument

According to Buckland (1991), information retrieval has been primarily concerned with written data; however, the author says that information retrieval should consider any phenomena that someone wants to observe, including images, sounds and objects, as well as texts. Digital documentation is relatively recent, but new techniques usually appear whenever there is a need to face new situations. A broader concept of document has been around for a long time; Suzanne Briet (1951) was a leading theorist who no longer considered bibliography and information retrieval based solely on texts as ways of accessing pieces of evidence. Having been neglected for a long time, her ideas are now widely accepted, even if not credited to her. With ICT, multimedia evidence is sometimes the main, if not the only, way to retrieve information about specific phenomena.

In his work, Buckland (1991) does not refer to the physical manipulation of cultured artefacts considered during the actions of documentation and retrieval. He declares though that advances in information technology remove constraints and increase our flexibility (p. 588). He distinguishes four categories to better explain what we are referred to here digital documentation (see figure 9).

Figure 9. Categories present in the digital documentation process



Source: Buckland, 1991 (modified by the author)

A document is a repository of expressed thoughts and habits, and its definition will depend on the environment we are talking about. Buckland (1991)

draws attention to the fact that currently pictures and sounds are handled in the same physical medium as other forms of expression and representation such as texts; besides this, new technological media welcome other and new forms of expression, but also manipulation. This flexibility adds greater capabilities for creating new representations; we can now collect, preserve, organize, disseminate, and select using new techniques designed to manage the rising flood of documents.

Each new technology comes with new affordances[77] (which are predetermined but also continuously extended and created by individuals' use). Digital technology provides access to myriad of types of evidence. Also, information systems can be used not only to find material that is already documented, but also to re-arrange material so that someone may be able to make use of it as (new) evidence for some purpose.

A digital environment contributes not only to think about the documentation work, but also to organize teachers' documentation actions, resignifying its nature, as digital technology allows new forms of representing cognitive material (for example, 3D shapes and development of a process over time - animations) and introduce new pedagogical methods (for example, collaborative projects). Media are increasingly present in teachers' practices, training, and production; Pretto (1997) affirms that information is an important construct for all human activity, because all individual and collective processes are directly affected (although not determined) by new technological media[78]. As such, documentation made digitally is aligned with technological progress and appears as a possible and appropriate instrument to bring together, register, and investigate actions and production made digitally[79].

In addition, digital technologies facilitate access to different cultures, thereby shortening distances and time lapses; they link the local, here and now, to the non-local; they connect specific cultures (which are situated in space and time) with whatever can be absorbed through the many peculiar interactions with other cultures (Pretto, 1997). Pedagogical digital documentation overcomes the

[77]For more on the concept of affordances, see Gibson (1977).

[78]"(...) a informação é parte integral de toda a atividade humana, todos os processos de nossa existência individual ou coletiva são diretamente afetados (embora certamente não determinados) pelos novos meios tecnológicos". (Pretto, 1997, p. 77).

[79]For example, films, animations, performances, soundtracks, distance learning and others.

classroom's physical boundaries; it facilitates access, modification and the remixing of its contents; it guarantees a better visual scheme, it allows for an extraordinary variability of forms to register events, and fosters sharing. All this strengthens the knots of an extended epistemology and is a vital element in the collective process of knowledge building.

Our research will investigate the belief that with digital documentation, cognitive resources are more easily shared socially, as well as discussed, criticized and revisited. These features more likely facilitate and enable collaboration and reflection.

2.3. Documentation and the proposal of this study

We propose investigating teachers' digital documentation work, the way they organize, register, reveal, and question practices; digital documentation work that is embedded within critical reflection on teachers' own actions and beliefs; digital documentation work that is able to account for different media productions and recognizes their importance as modern evidence for demonstrating knowledge building.

We will try to understand the nature of documental genesis that is constituted through instrumental genesis. We will investigate the interaction between teacher and pupil, between teacher and physical cognitive instruments, and between teacher and digital media, looking for meaningful patterns. We will pursue the opportunity of identifying ways to improve individual and collective practices, as reflection, when it happens, extrapolates solely individual practices; once a professional reflects upon his/her practice there is a positive externality to his/her modified, improved and new practices, reaching other professionals and stakeholders.

The topics discussed in this chapter indicated a gap in the literature concerning documentation work done by middle school teachers. Our understanding is that teacher's documentation work is indeed a powerful instrument to unveil and enhance teaching practices; whilst it is situated in time, its genesis and manipulation involves mediation and a reflective attitude.

We will now turn to our theoretical framework, presenting the key concepts and constructs used to ground our study and direct our data analysis.

3
THEORETICAL FRAMEWORK

"The credit belongs to the man who is actually in the arena …"
Theodore Roosevelt

In education, to document something presupposes an action mediated by instruments, in this case, an action between individuals or a group of individuals in a specific didactic situation and resources (including cultural artefacts). Digital documentation presupposes even more; it happens through interaction with the digital universe (mediated by computers) that is, by whatever means, used as an instrument. We can say that mediated action and digital resources are key factors for documentation work; digital resources are participants of a social process in which the document is created. The investigation and analysis of this process constitutes our object of study.

Our study will focus on a documentation that is cyclic, flexible, inclusive, and has many components, allowing for new practices and diverse content, being part of and facilitating the reflective documentation process, inviting the *remixing* of resources, and modifications. A utilization scheme that results in this model of digital documentation will depend upon the recognition of the potentialities of the technological resources as a fundamental factor for building up shareable, accessible, flexible and wide-reaching knowledge.

Historically, documentation concepts have been associated with the art of archiving and registering using paper basically, incorporating written language; but in the present day, by *documents*, we understand all the instruments able to register practices and events as different phenomena, such as videos, audios, pictures, speech, etc., with their corresponding schemes of use. Bearing in mind this diversity in nature, when documentation work is realized through digital means, it embraces more dynamic practices, with more speed and accuracy. Hong and Trepanier-Street (2004) emphasize that technology affords an extension of learning opportunities and also of communication to the professional community, which results in rich and meaningful material to be used in debates and professional development. They also observe that the use of technology facilitates access to documents and the development of a database.

The meaning of words and the specificity of some concepts are constituted at the center of a culture and are historically modified through time. They are inevitably linked to language and they should be understood and applied to the understanding of events keeping in mind the peculiarities of the circumstances in which they were conceived. As our study's theoretical framework is based on some key concepts, used in the search, selection, and interpretation of data, we must now explain the main concepts in more detail.

3.1. Activity Theory

In the first half of the 20th century, Russian researchers proposed a new perspective for analyzing and understanding psychological processes and circumstances, which some have called Cultural-Historical Activity Theory (CHAT). The idea was that individuals are situated in space and time and this must be considered as being part of the same unit of analysis when investigating and looking into any sort of cognitive phenomena; humans cannot be taken out of a social structure, a structure that is historically and culturally situated. The goal was to create a unified framework in support of the objective study of human consciousness through human participation in activities, through the relationship between human organism and the environment (Yamagata-Lynch, 2010). In 1977, Bandura introduced his Social Learning Theory, thereby attempting to explain human behavior "in terms of a continuous interaction between cognitive, behavioral, and environmental determinants" and adding that human functioning "neither casts people into the role of powerless objects controlled by environmental forces nor free agents who can become whatever they choose. Both people and their environments are reciprocal determinants of each other" (Bandura, 1977b, page vii).

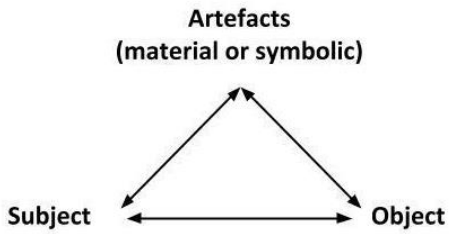
In his work, Engeström (2001) sustains that it is the use of cultural artifacts in any human action that precludes any sort of investigation that ignores the environment in which humans live. In the same direction, we cannot understand "society" without considering the space producers and consumers of artifacts cohabit.

For the Russian school, this interaction with the environment necessarily happens through an active dialogical process that occurs when the real situations identified by the subjects trigger their mental schemes (attempt at identification, accommodation, transformation, application, etc.), which is followed by a corresponding external action (objective action) (Engeström, 2013; Hashim and Jones, 2007; Vygotsky, 1978; Yamagata-Lynch, 2010).

According to Leontiev (2009a), the object of an activity and the activity itself imply one another. It is exactly the difference between objects that distinguishes one activity from another, as the object gives some orientation to the activity itself. Leontiev refers to such object as "motivation" and asserts that "it can be both material and ideal; it may be given in perception or it may exist only in imagination, in the mind." (Leontiev 2009a, p. 6)

This structure of analysis (human activity) was originally conceived with three components; the subject, the object, and the artifacts (instruments)[80] (see figure 10)[81]; but it was extended to accommodate cultural-historical components that not only influence but determine human activity (see figure 11).

Figure 10. Mediation action representation



Source: modified from the original model
for mediated action by Vygotsky (Engeström, 2001).

In the first model, known as "first generation" Activity Theory (Yamagata-Lynch, 2010), it is possible to notice that the structure of the analysis is the individual himself. The direct relationship between subject and object that arises without mediation represents elementary functions, generally associated with

[80]The subject is the individual who is investigated; the object is the planned activity, the instruments, and the artifacts used as resources during the activity.

[81]Hashim and Jones (2007) clarify that, when part of the activity, an artefact turns into an instrument.

physiological aspects, characterized by immediatism and defined through perception (Tosta, 2012).

The relationship between the subject and the object through artifacts (which become instruments as the intermediation takes place) characterizes the development of the higher order psychological functions; such interaction constitutes the development of consciousness[82] (Vygotsky, 1978). The mediating artifact/tool can include other artifacts or prior knowledge for example.

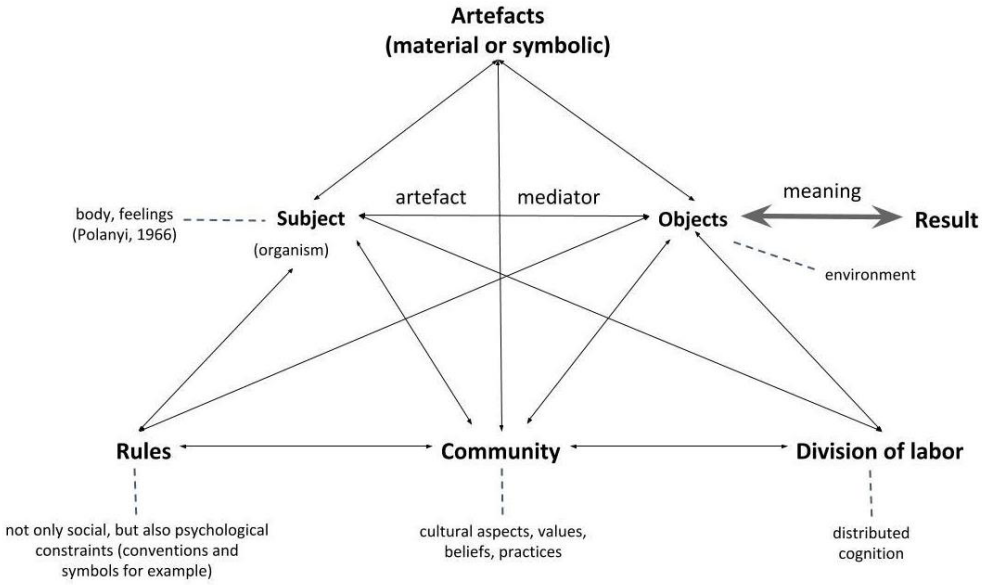
In other words, it consists of interactions in which the individuals engage and allow for opportunities for mediated action, which contribute to the social formation of their consciousness. In these interactions, the individuals are not passive participants, waiting for the environment to investigate the meaning-making process; *men* make meaning of the world while they modify and create activities through mediation processes, transforming artifacts, tools, signs, and people (Yamagata-Lynch, 2010). Polanyi (1966) also highlights the participation of our body in the cognitive processes when he says that tacit powers interpret the world around us by converting the impacts between our body and the things that come our way into a comprehension of their meaning, and that this comprehension is both intellectual and practical. For the author, the circle of comprehensive entities is then extended to include, apart from our own action, both the performances of other persons and these persons themselves (Polanyi 1966, p. 48-49). He adds that because our body is involved in the perception of objects, it participates in our knowing of all other things outside (Polanyi 1966, p. 29).

> Our body is the ultimate instrument of all our external knowledge, whether intellectual or practical. In all our waking moments we are relying on our awareness of contacts of our body with things outside for attending to these things. (Polanyi 1966, p. 16-17)

[82]Our consciousness is relationally structured. On analysing Vygotsky's work on consciousness, Shotter (2006) says: "…consciousness is a socially responsive elaboration of our animal sensitivities to, and awareness of, events occurring in our relations to the others and othernesses in our surroundings. Thus, far from it being a special, private, inner theater or workshop of the mind, its emergence depends completely on the intertwining or intermingling of our 'inner lives' with the 'inner' lives of those around us."

The extended model of the Activity Theory contemplates other dimensions; it is known as the "second generation" and is based on Leontiev's work. This model emphasizes the collective/cultural dimension of human activity (Yamagata-Lynch, 2010) and introduces three new constructs: a) the rules (resulting from social context) that help to determine parameters for individual action; b) the division of labor, which determines how actions and operations are divided within a group; and c) the community, which is determined based on the rules and on the division of labor and as such would possibly be investigated and analyzed (Hashim and Jones, 2007). We present a modified model to contemplate Polanyi's work (1966) and also the concept of distributed cognition, explained in the next section.

Figure 11. Extended mediation action representation



Source: Activity theory extended model (Engeström, 2001), modified by the author.

The "way out" (figure 11) is only through the object. The activity is oriented towards it (object) and its realization will always be related to some uncertainty, some capacity for interpretation, and also susceptible to changes (Engeström, 2001). In fact, activity is constituted through interaction and mutual process, in which both subject and object are transformed. Here the activity has a hierarchical structure that is realized through the existence of a material or ideal reason. For Activity Theory, the activities are made up of actions, which in turn are made up of operations. The actions are all the result-oriented processes, a process that has a

specific objective. The operations are then the way these actions are realized (Hashim and Jones, 2007; Leontiev, 1978).

Applying the representation above to our study, we can illustrate the *activity* of digitally documenting using the structure displayed (figure 11): documentation work based on a purpose, with an intention, a motive, that is the belief of its importance for facilitating pedagogical work, for fostering reflection during a pedagogical process, for improving organization and developing didactical material. The action of gathering and registering materials, students' work, pieces of communication, evaluations, alternative resources, assessments and so on are the *objective* of the activity; and the *operation* is the words chosen, the formatting of the documents, the media chosen, the examples given.

In his interpretation of Leontiev, Mendonça (2009) defends that pedagogical documentation is constituted as an activity if it is connected to social-cultural motivation, in this case, the humanizing aspect of a teacher's practice. Human activity and the mediation processes contribute to the formation of individual consciousness within an evolving environment; such that there would be no sense in thinking about an activity without social consciousness (Yamagata-Lynch, 2010). We can then claim that activity theory is deeply related to processes involving subjectivity and objectivity such as pedagogical activities. Based on Leontiev's *The development of mind* (2009b), "man's activity is the substance of his consciousness" (Leontiev, 2009b, p.419), so it is also closely linked to both knowledge development and expanding cognitive processes.

Based on Theory of Activity, we will investigate the documentation work (its motivations, objectives and outcomes) resulting when teachers and digital resources interact.

3.1.1
Extended mind and distributed cognition

The concept of extended mind is anchored in the idea that an individual is historically and culturally situated. When men manifest their existence by interacting with their fellow humans and with the environment through time, they create necessary and sufficient conditions to develop cognition (Cole and Engeström, 1993).

The Extended Mind Theory (Clark and Chalmers, 1998) is related to the investigation of cognitive processes and how they are constituted and realized. Clark and Chalmers (1998) affirm that cognition extrapolates our brains and is also manifested in the external environment; they defend active externalism (Lyre, 2015), under which external resources play a contributive role and have an assertive impact on the cognitive process[83].

Liu et al. (2007) advocate that knowledge emerges from interaction; artifacts manifest their affordances[84] facilitating the accomplishment of assignments and tasks, making them more efficient or even allowing and enabling specific actions. In the same direction, Hutchins (1986), and Cole and Engeström (1993) associate more complex physiological functions with the need to access resources available only in the social environment (for example, work with big data). Diaries, computers, and checklists incontestably improve the reach of our memory and the ability to process data and store information. Such external resources can also offer visual schemes that are more easily accessed and shared.

Clark and Chalmers (1998) sustain that the extended mind concept can be socially interpreted. In fact, considering its authenticity, accessibility and level of trust, there is no reason why not to make it available and shareable by other agents. These authors also define the coupled system based on the "active role of the environment in driving cognitive processes" (p.7) when interacting with organisms. Different organisms can drive similar cognitive processes if accessing similar environments. Clark and Chalmers (1998) drew attention to the role played by language and discourse as they complement and extend our knowledge and conceptual schemes[85] in a way that would not be possible by relying only on internal structures.

Overmann and Malafouris (2017) explain the distinctions in which situated cognition is referred to as embodied, embedded, extended, distributed, dynamical, and enactive. Briefly, they differentiate them as follows (p.1):

[83]About active externalism: "In these cases, the human organism is linked with an external entity in a two-way interaction, creating a coupled system that can be seen as a cognitive system in its own right". (Clark and Chalmers, 1998, p.29)
[84]Gibson, 1977.
[85]Vergnaud, 2009.

- *embodied*: “when the mind is influenced or constituted by the resources and processes of the body”.
- *embedded*: “when the mind is influenced by the resources and processes of the natural and/or sociomaterial environment”.
- *extended*: “when the mind is constituted by the resources and processes of the natural and/or sociomaterial environment”.
- *distributed*: “when the mind is considered to be part of a network of interacting agents”.
- *dynamical*: “when cognition is understood and analyzed as a complex dynamic system”.
- *enactive*: “when cognition arises through the dynamic interaction of brain, body, and the material environment”.

In our case here, we will focus on the concepts of extended, distributed and enactive cognition[86], because of the importance we are giving to external instruments for cognitive processes; however, when these processes are recognized as situated, they become associated with social, linguistic, cultural and material contexts (p.6), and the boundaries of the distinctions mentioned above surely constitute a gray zone.

The socially extended mind is recognized when professionals use digital documentation made collaboratively, for example, by the individual himself or by others; for either personal or professional use, and in various moments, to register, organize, reuse, inform, communicate, recall, etc.

Extended Mind Theory is related to Activity Theory because “extension” happens through the interaction between individual(s) and environment. Cole and Engeström (1993) rely on the dynamic aspect of Activity Theory and detail the cultural, social, and temporal[87] components that ground the concept of distributed cognition.

Cognitive distribution is a process in which cognitive resources are socially shared in order to improve cognitive capacity or to make specific knowledge possible; distributed cognition is associated with the dissemination of forms of knowledge, information and expertise among individuals or between individuals and artefacts; it presumes that intelligence is expressed in such relations and not only individually (Nardi, 1996). In other words, distributed cognition can be

[86]On enactive cognition, see Di Paolo et al., 2010.

[87]*Chronological*: happenings in the past create needs and reasons for interactions. Individuals remember or appeal to the past to project future actions and attitudes. This movement feeds present interactions. *Social*: all interactions are socially situated. *Cultural*: cultural diversity provides a convenient and promising arena for human interaction (Cole and Engeström, 1993).

linked to the products resulting from interaction between agents and objects that one individual could not have produced alone, for example, an animation, or a presentation using rotating figures.

For Extended Mind Theory, when an action is realized, depending upon favorable, accepted, and continuous conditions, processes can turn into routines, even unconscious ones leading to crystallized procedures (unconscious operations), and constituting social knowledge fit to be distributed.

Norman (1991) assumes the postulates of extended mind and distributed cognition and specifies and describes cognitive artefacts as the ones designed to maintain, represent, and operate according to specific information. The author recognizes that many artefacts improve our cognitive capacity, our degree of involvement, and allow the promises of a modern technological world to come true.

On the other hand, Kaptelinin and Kuutti (1999) oppose Norman (1991) and say that cognitive artefacts enhance mediation rather than increase cognitive capacity. These authors deny that this is merely a semantic matter. However, they also rely on Activity Theory to maintain their position: they assert that Activity Theory recognizes both internal and external components that constitute deliberate human action. Nonetheless, they say that such components are part of the same process. They also add that any appropriation process involves interaction, and results from personal, individual reasons and motivations. Kaptelinin and Kuutti (1999) conclude that distributed cognition results from previously planned mediation inherent to human social existence and its undeniable interaction with the environment[88].

Our work will consider that teachers' extend their cognition when using digital resources to search and work with information, document content and create diverse material to be used in their practices. We will also consider the use of computers during teachers' digital documental work, and how the use of Internet and other digital resources to create pedagogical content as examples of distributed cognition according to Cole and Engeström (1993). Digital documentation is a cognitive work, not only during its genesis, but also when it is accessed, because it reflects pedagogical practice. It is also a cognitive practice

[88]For a thorough critical investigation about the work of Clark and Chalmers (1998), see Menary (2010).

when shared, modified, reused, and recycled; but mostly it is even more relevant when it (documentation) is constituted as a result of a reflective practice.

3.2. Reflection

In his book, *How We Think* (1933), Dewey defines reflection as "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends (p.6)". He states that reflective thought is like a suspended judgment, one that waits for further and conclusive investigation about the problematic situation that originated that thought (p.13). Dewey adds that reflective practice depends on open-mindedness, responsibility, and sincerity. He identifies these attitudes as imperative for any reflective practice to happen. He also identifies the importance of critical thinking on judgment and the analysis of reality; he declares that any judgment results from a state of perplexity, confusion, and doubt (idem, p. 12), thus, reflection encompasses three stages, the past (before), the present (right now in the moment), and the future (after).

Clift, Houston and Pugach (1990) recall that the concept of reflection, however frequently and extensively applied today, is featured with it different perspectives, some more profound and complex than the others, like the ones presented by Johnson and Jay (2002), Valli (1997), and Schön (1993) (see table 1).

Schön (1983, 1995, 1996) and other authors (Artigue, 2002; Borko et al., 1997; Clift et al., 1990; Hasseler and Collins, 1993; Margolinas et al., 2005; Rodgers, 2002; Shulman, 1992; Thompson and Pascal, 2012; Trad, 2009; Zeichner, 2008) confirm that when reflection is critical, it is a fundamental piece for transformative learning to happen.

Schön grounds his theory on Dewey's when the latter defends that learning emerges from doing. Based on this idea, we cannot teach a student content that he/she does not want to learn about; we can say and even show; however, he/she will only learn through self-experience. Therefore, the teacher should commit himself/herself to the didactic situation proposed and make an effort to see the results of his/her own actions and rethink his/her decisions in face of the analysis

of the results achieved; the teacher learns to be a reflective professional through reflecting upon his/her pedagogical practice. To this end, digital documentation may work efficiently, as it provides an opportunity for reviews and evaluations. Digital documentation affords resources such as online communications with parents, digital students' work, testimonies, videos about classroom practice, and animations, for example, to constitute and feed memory about both professional work and teachers' attitude during a pedagogical process, offering different perspectives for the work done, and facilitating reflection about intended goals and achieved results.

In this regard, Schön (1983) proposes an epistemology of practice, which is supported by concepts such as "knowledge on action", and "reflection on action". *Knowledge on action* is the component that is directly related to the idea of "knowing how to do"; it is spontaneous, implicit and emerges from action, namely tacit knowledge. Therefore, reflection is revealed in unexpected situations that originate in action; *knowledge on action* is not always sufficient to deal with practice situations; there are some sort of thinking, regulations by feelings and emotions, and adapting in the process. Schön also talks about three kinds of reflection: reflection about action, reflection in action, and reflection about reflection on action.

Reflection on (about) action consists of thinking retrospectively about what we did, seeking answers on how our "knowing-on-action" could be related to the results. *Reflection in action* consists of reflecting while the action is happening, without interruption. Our thinking leads us to contemplate alternatives to deal with a complex, unplanned situation that is happening at the moment. Differently, a third case is *reflection about the reflection in action* that has already happened, consolidating the understanding about a specific situation, which allows the planning and the adoption of a new strategy for future practice.

According to Perrenoud (2002), reflection is part of our lives and is broadly present in our actions. Nonetheless, we should be automatically considered reflective professionals. Reflective practice should be a *habitus*[89], it should be

[89]Asimaki and Koutsourakis (2014, p. 125) will attempt to explain Bourdieu's concept of habitus as follows: "In this definition, Bourdieu considers habitus firstly to be a 'system of continuous and transferable dispositions'. When Bourdieu refers to dispositions he means the individuals' positions and tendencies, in terms of the particular way they think, feel, act, understand and which they have embodied and internalized, not in a conscious way, but through pedagogical processes

associated with an attitude, a professional identity. The author also refers to different forms of reflective practices: *reflection in action*, and *reflection on action*. *Reflection in action* is a higher-order level of competency, whereas *reflection on action* is a source for information about the development and evolution of professional knowledge and competence (Perrenoud, 2002). In addition, according to the author, talking about teaching competency entails content knowledge, social relations, pedagogical abilities and ethical values. To be competent is to know how to deploy and apply knowledge, but most importantly, it is to adapt, to notice new demands, and to continue to challenge one's own beliefs and values.

Also, another element of reflection is peer collaboration. Collaborating and sharing not only offers material to be re-signified and used as instruments in other practices, but it is also fundamental for reflection. Comments, critics and reflections help professionals face their blindness about their attitudes, motives, feelings, and beliefs (Engeström, 2008; Gueudet et al., 2013 and 2016; Hasseler and Collins, 1993; Meirink and outros, 2010; Nan, 2008; Vangrieken et al., 2015).

Based on the theoretical framework proposed, our field study will try to gather evidence that the teacher documentation genesis framed and structured under digital baselines constitutes indeed an element of reflection about teachers' practice; consequently, it can be understood as an instrument to improve practices.

3.2.1
Reflective practices

In the literature, "reflective practice" has been associated with teaching improvement. There is also evidence that documentation facilitates and can be considered as an instrument of reflection[90], and that the use of ICT - which can be considered as a relevant modern pedagogical resource - enhances, expands, redefines, and speeds up pedagogical processes, besides enabling digital sharing and collaboration practices.

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and socializations at the base of the objective social conditions of their existence, but also of their social 'orbit'. These dispositions tend to function as non-conscious principles which guide practice, and in general perception, but also every reaction of the individuals."

[90]Even though there is extensive literature about reflection and its many levels of criticality (see section about "reflective practice"), for the investigation of teacher's documentation work, we will refer to the attitude/action of thinking through, seeing again, writing about; any performance that involves metacognition.

Practical reflective thinking is identified as one way to learn from experience. Through reflective practice, we can analyze our *praxis* from a critical perspective, as we try to comprehend and make sense of it, considering the context in which it was constituted; we act deliberately to address concerns and solve problems emerging from everyday educational processes.

Learning from practice is different from the knowledge that is developed only in theory, despite its importance in understanding one's own practice. Learning from practice also differs from learning achieved during observation and reproduction of behaviors not grounded on critical reasoning. Reflective practice intends to close the gap between pure theory and direct, routine-like practice; it seeks meaningful knowledge development, better able to understand and improve reality (Jasper, 2003; Schön, 1983; Zeichner, 2008).

Zeichner (1987) and Shulman (1986, 1987) write about teachers' reflective practice and define it as a basic, fundamental skill for great teachers, those with the ability to develop continuous critical behaviors, question their own practice, considering the context in which it was generated. In his seminal article about preparing reflective teachers, Zeichner (1987) adds that the habit of questioning and critical behavior must transcend the meta-analysis of a teacher's practice, it must guarantee that action matches reflection and is aimed at improvement of the practice itself. Authentic and sincere reflection should guarantee a change in behavior and commitment to social transformation.

> For many, the term reflective teaching sounds redundant. It raises the following questions: In order to teach don't you have to think about your teaching? And isn't such thinking the same thing as reflecting on your teaching? These questions get right to the heart of the matter. In what follows, we argue that not all thinking about teaching constitutes reflective teaching. If a teacher never questions the **goals** and the **values** that guide his or her work, never considers the context in which he or she teaches, or never examines his or her **assumptions**, then it is our belief that this individual is not engaged in reflective teaching. This view is based on a distinction between teaching that is reflective and teaching that is technically focused. (Zeichner and Liston, 1996, p. 1)

Thompson and Pascal (2012) make a similar point when they acknowledge the lack of robustness of the theory that carves and molds the concept of "reflective practice", which they believe is quite surprising, considering its popularity and the importance it has in educational processes. The authors are interested in clarifying and consolidating the theoretical framework with elements that are at the core of this practice. They suggest that an authentic and efficient reflective practice is, fundamentally, *critical* (Jay and Johnson, 2002, p.77; and Valli, 1997, p.75). This stance goes against the well-disseminated idea that reflective practice is basically one in which the professional stops at times to think, without any sign of a more thorough and in-depth analysis or even traces of learning resulting from the recent, lived experience (Thompson and Pascal, 2012).

The belief that reflection improves practice fosters the search for strategies that help teachers' critical ability. Zeichner (1987) considers six strategies to achieve this: action research, ethnography, writing, professional supervising, curriculum analysis and development, and the effort to create a methodology for reflective practice. In addition, Schön (1995a, p.90-91) suggests the implementation and more intense use of *reflexive practice*, and of statements that represent the real world, allowing us to experiment, evaluate attempts, make mistakes, analyze one's own errors and try again, thereby adopting modified strategies.

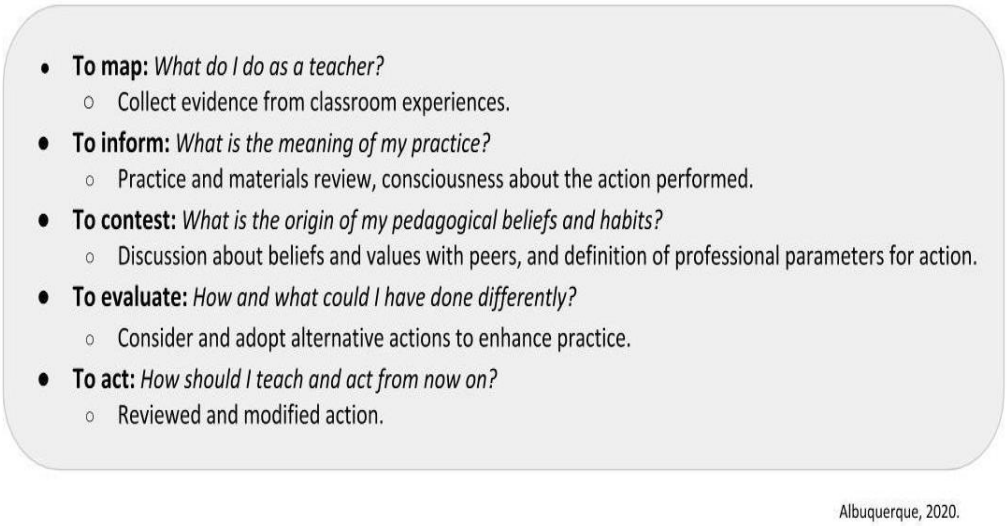
If we assume that reflective writing works as evidence of reflective thinking, then it can be considered as an important component of reflective practice. We can then investigate teacher reflective practice, its trajectory, and its content as a crucial instrument for reflective practice, which can develop into a reflexive attitude, an imperative factor for transformation[91].

[91]Researchers have attempted to differentiate reflective from reflexive practice. Bolton (2010) and Argyris and Schön (1974) appear to agree about the potential of reflexivity. Bolton affirms that "through reflexive practice professionals realise dissonance between their own values in practice and their espoused values, or those of their organisation, leading them to make dynamic change". For Argyris and Schön (1974), this *dissonance* arises when the individual engages in a *double-loop* reflection process, the only possible way to innovate, transform and change (See section 3.2.2.). According to Lipp (2007), reflexivity is argued to be a deeper and broader dimension of reflection. In his work, *Reflective Practice - writing and professional development*, Bolton (2010) defines reflective practice as "the development of insight and practice through critical attention to practical values, theories, principles, assumptions, and the relationship between theory and practice which inform everyday actions", and reflexivity as "focused in-depth reflection upon one's own perspective, values and assumptions" (glossary, p. xxiii). For the authors cited above, reflexivity is finding strategies to question our own attitudes, thought processes, values, assumptions, prejudices and habitual actions, to strive to understand our complex roles in relation to others. To be reflexive

Many authors elaborate on the process to develop reflection to allow for reflective practices. For example, Bartlett (1994) suggests a 5-stage cycle, Murphy (2001) presents a process in 10 steps, and Gibbs (1988) idealizes the reflective process as a circle (see figure 12)[92]. In all these interpretations, there is an understanding of what has happened, an investigation of the beliefs and habits involved in the pedagogical practice and on the results achieved, a search for promising, more efficient and appropriate alternative actions and, finally, deliberate action.

Figure 12. Proposals of processes to develop reflective practice

Bartlett (1994)



is to examine, for example, how we – seemingly unwittingly – are involved in creating social or professional structures counter to our own values (destructive of diversity, and institutionalising power imbalance for example). It is becoming aware of the limits of our knowledge, of how our own behaviour plays into organisational practices and why such practices might marginalize groups or exclude individuals." (p.13-14). Cousin (2013) says that "sometimes reflexivity is treated as a synonym for 'reflective practice' with the result that its distinctive attention to positionality and knowledge construction is neglected or simplified" (p.3). The author also says that while it is true that, in his work, Schon (1987), did not overlook this question, his notion of 'reflection on action' is read often precisely as a reflection on what the practitioner has done. In his article, *Reflexivity: The New Reflective Practice*, Cousin (2013) presents a definition from the Chartered Society of Physiotherapy (2013): "Reflective practice is a process by which you: stop and think about your practice, consciously analyse your decision making and draw on theory and relate it to what you do in practice"; however, he asserts that this view is limited because the lens is on 'your practice' whereas reflexivity includes a concern for positionality (p.4). Belbase (2016) adds that reflective beliefs "are related to critical examination of actions, objects, and environment. Whereas, reflexive beliefs are related to critical examination of participants' self-awareness and consciousness to the self-other interface" (p.43).

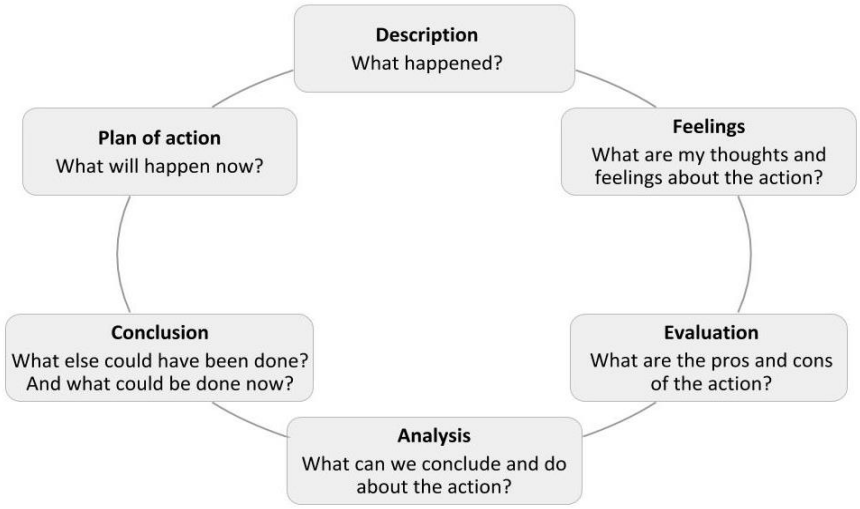
[92]For more models of reflection, see Borton (1970), Brookfield (1991), Gore and Zeichner (1991), Johns (1995), and Kolb and Fry (1975).

Murphy (2001)

- Collect information about classroom practice.
- Examine data and investigate their meaning.
- Identify the teaching and learning process.
- Investigate and raise awareness about the habits and attitudes operating during a didactic scene.
- Discuss and collaborate with other professionals interested in reflective practices.
- Elaborate questions to be explored about the teaching practice.
- Identify resources to help clarify and solve the questions at hand.
- Intentionally modify practices, even if they represent small changes.
- Document changes, and their respective evolution and results.
- Persist in the critical process, one that questions and modifies practices, over time, always sharing experiences with peers.

Albuquerque, 2020.

Gibbs (1988)



Albuquerque, 2020.

Even though we can identify an intention to provide teachers with a framework to reflect on critically, we suspect that this aspect has not received appropriate and deserved attention. One might think that reflection is an easy matter or that it fits well into the organized schemes offered.

In his book, *The reflective practitioner*, Schön (1983) relates reflective practice to professional development; nonetheless, he condemns the use of pre-established rules and methods for solving problems in social and personal endeavors. Not only Schön, but the literature about "social" professionals in general, such as nursing and social work (Price and Harrington, 2016), intensely criticize rational approaches and techniques when they feature the adoption of rigid pre-established artificially tested practices, which, according to Rolfe et al. (2001), dehumanize professionals due to treating them as technicians; in this

scenario, it is expected that these professionals will analyze patterns according to well-defined rules, not considering individuals and social processes according to their real nature, one filled with uncertainty and unpredictability, in Schön's words, the "*swampy lowlands"*[93].

Aligned with Schön, Bartlett (1994) conditions reflective practice to the projection of teaching practices. For him, to become a critical professional means to transcend technicalities and think beyond the need for better, faster and broader methods. He suggests that we move away from questions about processes (how) to questions about purpose and meaning (what and why). This last approach empowers teachers as they have a chance to exercise their control over didactic situations, offering possibilities to choose and to transform.

> Asking "what and why" questions gives us certain power over our teaching. We could claim that the degree of autonomy and responsibility we have in our work as teachers is determined by the level of control we can exercise over our actions. In reflecting on the above kind of questions, we begin to exercise control and open up the possibility of transforming our everyday classroom life. Bartlett (1990, p.267)

Jay and Johnson (2002), Valli (1990, 1997), and Schön (1995) identify different moments for reflective practice according to its characteristics. Jay and Johnson define a typology for reflection and present it as descriptive, comparative, or critical. Valli (1997) identifies 5 different categories in his analysis, naming them technical, reflection in and on action, deliberative, personal, or critical. Schön (1995) distinguishes 3 types of reflective practice: reflection about the action, reflection in action, and reflection about the reflection in action (see table 1).

Table 1 - Reflective practice categories

[93]Shön refers to this unpredictable, confused environment that is full of peculiarities as the "*swampy lowlands*"; he has said that this is the scenario in which most of human matters takes place. The pedagogical process is indeed uncertain, dynamic, unpredictable and, for that reason, technical solutions to the problems that emerge are not suitable. "The dilemma of rigor or relevance. In the varied topography of professional practice, there is a high, hard ground overlooking a swamp. On the high ground, manageable problems lend themselves to solution through the use of research-based theory and technique. In the swampy lowlands, problems are messy and confusing and incapable of a technical solution. The irony of this situation is that the problems of the high ground tend to be relatively unimportant to individuals or to society at large, however great their technical interest may be, while in the swamp lie the problems of greatest human concern. The practitioner is confronted with a choice. Shall he remain on the high ground where he can solve relatively unimportant problems according to his standards of rigor, or shall he descend to the swamp of important problems where he cannot be rigorous in any way he knows how to describe?" (Schön, 1995b, p.2).

Jay and Johnson (2002, p.77)	Valli (1997, p.75)	Schön (1993)
DESCRIPTIVE Describes the matter of reflection. *What is going on?* *How do I feel?* *Is this working? For whom?*	**TECHNICAL** Matches one's own performance with external guidelines.	**IN ACTION** Improvises, varying the combination and recombination of a set of figures within the utilization scheme in order to give coherence to the performance. Answer to student's tacit knowledge.
COMPARATIVE Reframes the matter of reflection in light of alternative views. *How can I improve?* *What are the alternative views of what is happening?*	**IN-AND-ON-ACTION** Bases decisions on one's teaching performance and own unique situation.	**ON ACTION** Reflects after one's own action to uncover knowledge used in a particular situation, by analyzing and interpreting the information recalled.
CRITICAL Establishes a renewed perspective, having considered the implications of the matter. *Given these various alternatives, their implications, and my own morals and ethics, which is best for this particular matter?*	**DELIBERATIVE** Reflects based on different perspectives of pedagogical practice. Considers competing teaching concerns and research findings.	**A BOUT THE REFLECTION ON ACTION** Thinks about future actions with the intention of improving or changing practice. Reflects on past experiences.
	PERSONALISTIC Listens to and trusts one's own inner voice and the voices of others. Reflection based on personal beliefs and the exchange of opinions. Personal growth and active dialogue with students.	
	CRITICAL Judges the goals and purposes of schooling in the light of ethical criteria such as social justice and equality of opportunity	

Source: the author.

Thompson and Pascal (2015) drew attention to the kind of reflection that happens when planning the action, that considering past experiences and the knowledge resulting from such experiences in order to maximize time and available resources.

Korthagen and Vasalos (2005) advocate that sometimes deeper and broader reflection is necessary; they call it *core reflection*, meaning inner, nuclear, substantial reflection. The authors affirm that the teacher's individuality and personality have a key role in his/her actions. They develop a reflection process known as ALACT (**A**ction - **L**ooking back - **A**wareness - **C**reating alternative methods for action - **T**rial)[94] of what they call the "*onion*" model in order to better comprehend the level at which complex (*core*) reflection is situated. The authors argue that the ALACT model describes a structured reflective process, but it does not tell us very much about the content of reflection: what does or should the teacher reflect upon? The authors justify the relevance of the core reflection ("onion") model[95] as follows:

> This model (ALALC) builds on the assumption that by nature people reflect on their experiences, but that systematic reflection often differs from what teachers are accustomed to doing. If we look closely at how teachers generally reflect, often influenced by the specific school culture, we see that the pressure of work often encourages a focus on obtaining a 'quick fix' - a rapid solution for a practical problem - rather than shedding light on the underlying issues. While this may be an effective short-term measure in a hectic situation, there is a danger that one's professional development may eventually stagnate. In some cases, teachers unconsciously develop standard solutions to what they experience as problems so that the accompanying strategies become frozen (Schön, 1987). The teacher is no longer in the habit of examining these strategies, let alone the analyses he or she once made of the problems they are intended to address. Thus, structured reflection is important

[94]Korthagen and Kessels (1999) defend a realistic theory to be used in teacher education aimed at structure reflection. They claim that it should serve as a bridge between theory and practice. This theory should entail i) consideration of real situations to inspire teacher education, ii) reflection and personal interaction to discuss ideas and beliefs, iii) rethinking and reinvention of practice based on professor orientation, iv) attention to theories based on *phronesis* and not only on *episteme*. These principles are presented in a circular model with five phases: (1) action; (2) reflection on the action; (3) awareness of essential aspects; (4) creating alternative methods of action; and (5) trial of a new action/approach (this stage corresponds to stage 1 of a new cycle). For more information about the ALACT model, see Korthagen et al. 2001; Korthagen and Kessels, 1999; Korthagen and Vasalos, 2005; Korthagen et al., 2006.

[95]For more detailed information about the levels of the "onion" model, see Korthagen (2004): "In search of the essence of a good teacher: towards a more holistic approach in teacher education".

> in promoting sound professional behavior. It also supports the development of growth competence (Korthagen et al., 2001, p. 47): the ability to continue to develop professionally on the basis of internally directed learning. (Korthagen and Vasalos, 2005, p.48)

Korthagen and Vasalos (2005) believe that critical reflection based on experience can modify behaviors, change beliefs, model professional identity and redefine goals, according to where and how pedagogical experience is perceived, understood and interpreted.

In this sense, we can say that reflective practice is one that looks into the past and into the present to better decide about the future; the professional observes, thinks about, and contextualizes a specific experience in order to better understand it and model future, more promising actions, which depend on the goals previously set and achieved. Therefore, reflective practice is the process in which reality, meta-analysis, planning for future actions, and actions already taken, will determine future decisions, thereby re-signifying beliefs, values, and attitudes. To act reflexively means to understand that preceding history does not justify the continuity of old practices (Schön, 1995a).

3.2.2.
Reflection and transformation

Based on the previous section, we suspect that committed teacher documentation results from critical reflection devoted to ethics and seeking transformation. Authors such as Argyris and Schön (1974); Dewey (1933, 1974); Kumaravadivelu (2003); Maddux and Johnson (2006); Sovacool and Hess (2017); Sterling (2010); and Temporelli (2016) approach related aspects of such transformation.

In their work, *Theory in practice: increasing professional effectiveness,* Argyris and Schön (1974) offer a conceptual framework for reflective practice by analyzing the theories of action that determine all deliberate human behavior. In fact, they say that "all human beings - not only professional practitioners - need to become competent[96] in taking action and simultaneously reflecting on this action to learn from it" (p.4). As such, the theory of action tries to explain the mechanism by which we link our thoughts to our actions. It is composed of many

[96]We will use the term competence as the ability to do something well and efficiently.

elements such as *action strategies*[97], consequences for oneself and for others, *governing values*[98], and action strategies' effectiveness. The issue is that the *theories in action* are two-fold. There are the *espoused theories*, the ones that describe and justify our behavior, and the *theories in use*, the operational theories implied by our behavior. We can simplify by saying that the former is what we think, and the latter is what we do. *Theories in use* are the means for getting what we want (resolve conflicts, make a living, control certain variables, etc.). They are created and modified to provide means to manage variables.

The authors explain that there are *beliefs*, *feelings*, and *intentions* in the process of any action and that most of the time we are not aware of their influence on our actions[99]. In addition, because of a tradition of not talking about self, about others and about feelings in general, the consequences of an action are often misjudged. After much explanation about the dynamics of social interaction, the authors differentiate between two forms of learning. They call them *Model I* and *Model II* (Argyris and Schon, 1974).

Model I (also called *single loop*) learning is grounded in a competitive and defensive stance towards the world; it involves generalizations of new action strategies to achieve existing governing values. In our work, we can compare this to a more descriptive or superficial reflection. There is a recognition of complexities and challenges, and there is a willingness to "fix" what is not working. Small changes are focused on the re-establishment of a "meta" equilibrium that is based on an existing system of values and beliefs. In this scenario, there is no encouragement for innovation and people are not supposed to express their true feelings and beliefs, as their ultimate goal is to "fit in" and belong to a group.

On the other hand, *Model II* (also called *double loop*) involves adaptation and modification of the governing variables themselves; there is collaboration and there are dialectical and interactive relations; overall values are open to challenge. We might add that the *double loop* is based on short-cycle evaluations, which

[97]**Action strategies** are behaviors performed to manage surroundings, for example to maintain an important belief.

[98]**Governing values** (or variables) are goals we seek to satisfy, beliefs we seek to operationalize and defend, values we seek to express, for example. One's action can be motivated by the goal of maximizing wining and minimizing losing.

[99]For more on embodied cognition, refer to Johnson (2015).

require a questioning, feedback-sensitive mindset. In short, *single-loop* learning is when a practitioner or an organization, even after an error has occurred and a correction is made, continue to rely on current strategies based on existing paradigms; *double-loop* learning implies the modification of attitudes, objectives, strategies or policies so that when similar situations happen a new framework is employed (Argyris and Schön, 1974).

The idea of *double loop* learning connects with some considerations from the recent work of Sovacool and Hess, *Ordering theories: Typologies and conceptual frameworks for sociotechnical change* (2017). The authors investigate the concepts that are most useful for explaining socio-technical change, more specifically, the adoption or diffusion of technology and how it can be integrated. Sovacool and Hess (2017) have conducted extensive research to identify the most frequently-mentioned theoretical approaches used, and their focus on the constructs that constitute practices. They mention four such constructs: elements, entities, performances, and carriers. Elements are often material items that allow or constrain actions; entities are matters talked about or skills drawn upon when acting; performances relate to the immediacy of doing; and carriers are the individuals that host or perform an action.

When relating the work of Argyris and Schon (1974), and Sovacool and Hess (2017) to our own, we find common ground in the social aspect of the object of study and in the complexity that involves any desired transformation. Transformation results from dealignment and realignment movements based on uses of a new framework that allows for sustainable innovation; transformation results from the improvement of characteristics and/or intended uses of the resources.

Argyris and Schön (1974) mention the importance of being sympathetic to *double loop* learning in order to be open to change, to accept differences, and to be aware, responsive and welcoming about diverse beliefs and intentions. Along the same vain, Sovacool and Hess (2017) highlight different epistemological approaches and cite practice as the fundamental way to obtain information that is sufficient and precise enough to be meaningful when comparing, modeling and transforming; only when documentation work is based on authentic practice can one avoid misinformation.

Maddux and Johnson (2006) align their interest with Sovacool and Hess (2017) as they investigate possible transformation in education due to the application of ICTs. We can say that the first research presented (Argyris and Schön, 1974) was more general, indicating one specific learning path able to promote innovation (*double loop* learning). The last two studies mentioned above can be considered more specific, as they attempt to explain and to integrate ICTs into the pedagogical scene. The study, *Type II applications of information technology in education: the next revolution*[100], deals with differentiation between *Type I* and *Type II* applications of information technology in education. Similar to the single loop/double loop model from Argyris and Schön (1974), here the authors are more directive about their goal. They want to overcome *Type I*, which focuses on the technological applications that make processes faster, easier, but still compliant to traditional methods, and introduce/develop *Type II* applications, which allow for new and better ways of teaching, which are more integrated with new processes and learning outcomes.

Beyond methods by Kumaravadivelu (2003) addresses issues related to a mindset ready to welcome changes. The author corroborates a Deweyan view and defines teaching practice not as a sequence of predetermined procedures, but as a context-sensitive action grounded on intellectual thought. He cites Schön, Liston, Zeichner, and Dewey to draw attention to the fact that transformation is endorsed by reflective practice. In fact, one can say that not all teaching constitutes reflective teaching. Zeichner and Liston (1996, p.1) say that teachers should question the goals and the values that guide their work, the context in which they teach, and examine their assumptions, in order to be engaged in reflective teaching.

Kumaravadivelu (2003) states that strategic thinkers must be strategic practitioners and that a pedagogical framework must emerge from classroom experience and experimentation. For this to happen, we might think that the availability of a solid body of classroom research findings is fundamental to model, exemplify, inspire, and suggest changes that emerge from an authentic ground.

[100]From Maddux and Johnson, 2006.

The author describes three parameters of teaching practice: *particularity*, *practicality*, and *possibility*. *Particularity* seeks to facilitate location-specific pedagogy, which is context sensitive. *Practicality* seeks to rupture the reified teacher role as a reproducer of methods and to encourage them to produce a theory based on their practice and practice what they theorize. *Possibility* seeks to awaken and develop the sociopolitical and ethical consciousness that teachers have so that they can function as a catalyst to foster identity formation and social transformation (Kumaravadivelu, 2003).

Temporelli (2016) investigates conceptual change; he agrees with the previously cited authors in advocating that teachers' practice is a powerful environment for thinking about change. He agrees with Argyris and Schön (1974) and also refers to an existing dogmatic filter that imposes a crippling rationality that seeks the maintenance of the *status quo* (*Model I* / *Single Loop* learning), and also on beliefs, conceptions, assumptions, and feelings that are behind any action. Temporelli (2016) calls it "implicit conception" (*concepción implícita*). He also defends that modification only happens through reflection and that the transformation of implicit behaviors, beliefs and attitudes is the first step for a change in the system. He mentions teachers' feelings and other constraints such as time and willingness to endure conflicts (and opportunities) as important challenges for any meaningful and sustainable change to happen. Argyris and Schön (1974) had already drawn attention to the fact that *Model II* / *Double Loop* learning involves the whole environment and its specific types of relationships in order to be possible.

Temporelli (2016) worries about the dichotomy between theory and practice and mentions Kuhn (1959, 1998) when discussing models for conceptual change. The author does not defend one model as more efficient than others[101], but discusses research done on possible ways to welcome transformation. His suggestion has three main aspects: a) to make the invisible visible, b) to know about different pedagogical frameworks, and c) to develop cognitive abilities such as problems solving creativity and metacognition.

All the research mentioned here points to the importance of both the medium and the teachers in defining pedagogical processes. In addition, they all

[101]The models mentioned are: Conceptual Revolution, Macro Theory, Hypothesis Incompatibility, Explicit Representation, and Situated Learning (Temporelli, 2016).

refer to reflection as more than "thinking through", reflection as a fundamental element, a *sine qua non* condition for any pedagogical change. There is conscientization, there is wholeheartedness and open-mindedness, and also a cognitive, affective and existential dimension to be contemplated in order to immerse in *double-loop* learning, embrace *Type II* transformations and reach deeper levels of learning as mentioned in Sterling's "Level of Knowing Pyramid" (2010). When reaching the epistemic learning level, teachers might be able to, critically interact and engage with available resources, thereby proposing meaningful and collaborative activities to their students, and embracing the practice of documentation as an authentic instrument not only to enable visibility of teaching process, but also to contemplate the processual aspect of pedagogical theory, as documentation should be continuously performed, and encouraged to be validated by equals.

3.2.3.
Critical reflection challenges

We define critical reflection as that only form able to lead teachers who perform under predetermined materials and strategies that lack flexibility to become reflective practitioners with emphasis on developing teaching skills and flexibility to meet students' needs, and, on this basis, to take on their role as transformative intellectuals (Kumaravadivelu, 2006).

Nowadays, however, consensus around the key place of reflective practice in one's own pedagogical performance has found some obstacles (Vince, 1996). Thompson and Pascal (2015) describe some of those as follows: a) emphasis on the individual (which they call "atomism"), which ignores the social dimension of reflective practice and the environment in which it takes place; b) disregard for the emotional component always present whenever we reflect about oppression and discriminatory practices; and c) inattention to the power inherent in any discourse, which is able to manifest preferences and also suppress discussions about specific topics.

Kumaravadivelu (2003, 2006) also points out three shortcomings. He says that, by focusing on the role of the teacher, the reflective movement tends to treat reflection as an introspective process, and not one that should be interactive and inclusive of other parties such as students, administrators, and other teachers.

Secondly, the movement has given more attention to what teachers are doing in their classrooms, and how they are preparing their didactic scene, and not so much attention to the socio-cultural-political factors that are shaping their pedagogical practices. And thirdly, there is excessive reliance on established professional wisdom, which can work against the idea of being open to new methodologies and innovative practices.

In education, and more specifically in this work, we will define the ideal professional as one who analyzes and revisits his/her own practices, conscious about the challenges described above. From this perspective, teachers' theories of practice are the result of the entanglement of speculative theories (theories conceptualized by thinkers in the field), empirical research (authentic data from educational practices), and experiential knowledge (constructed from practice). The professional re-evaluates results, thinks about alternatives and changes, and shares experiences[102], always with the same objective in mind: the "best"[103] learning for his/her students.

Our research question seeks to investigate in which ways teacher's documentation work relates to reflection. Based on the previous section, we observed the many levels and forms a reflective attitude can be manifested. Argyris and Schön (1974), Maddux and Johnson (2006), and Sovacool and Hess (2017), for example, are assertive when they relate "true", "deep", "critical", "transformative" reflection to that questioning established paradigms, systems of power, and world view in light of justice, authonomy, and ethical values. We do agree with them. However, we also defend that reflection that is deliberative, comparative and happens in and on action (Schön, 1993; Valli, 1997; Jay and Johnson, 2002) is committed to the improvement of practice[104] and student learning. It seems to be a certainty that reflection assumes two different levels and also that the engagement on those different processes depends on the objectives, purposes and, why not say it, determination of the subject in action. Our

[102]According to Perrenoud (2008), this sharing is a fundamental factor for successful reflective practice.

[103]One that is liberating and critical, one that develops abilities and knowledge that guarantees the exercise of citizenship.

[104]We will call "improvement of practice" here that looking for differentiation of instruction, with awareness of students' individualities, implementing formative assessments, using diverse tools and resources on the teaching-learning process, worried about giving feedback to students, for example; not necessarily engaged in questioning the status quo of the educational system in place.

investigation examines teachers' data looking for traces and signs of these reflective attitudes.

Reflective practices are empowering instruments for teachers because they develop and improve their consciousness about their ability and possibilities as professionals, besides facilitating transformations and professional development through revision of beliefs and habits. Among the suggestions and tentative practices for developing reflective behavior, pedagogical documentation appears to be promising.

To better understand documental genesis and documental practice (in section 3.4), and how its trajectory happens, we must first understand the dynamics between the teacher and the resources create during his/her documentation process. These dynamics are better explained if we take one step back and examine them through the lens of the concept of instrumental genesis.

3.3. Instrumental Genesis

An instrument is not a given entity, its existence depends on the course of use of an artefact. Rabardel (1995, 1999) relies on psychological concepts such as Piaget's[105] *scheme* (Piaget, 1967, p.16), which was later extended by Vergnaud in his Conceptual Field Theory[106], on the concept of *intermediation* by Vygotsky (1980, 1998), and on *Activity Theory* by Leontiev (1978) to design *Instrumentation Theory*. Its purpose is to investigate and understand human action as mediated through artifacts and their transformation into instruments.

Humans engage with artifacts when acting towards a goal. Subjects reflect upon and use them to solve problems. The artifacts become instruments when they are used during an activity with a specific objective. Bannon and Bødker (1989) add that artifacts can indeed be considered as crystallized knowledge, as, in general, they emerge, are modified, and evolve when incorporating the

[105]We will consider a scheme of action whatever is, during an action, transposable, generalizable, or differentiated between one action and the one that follows; in other words, it is whatever is common to the many repetitions and/or applications of the same action (Piaget, 1967b, p. 16). A "scheme" refers to a class of situations somewhat similar and related to a group of actions; schemes refer to what is repeated when action happens. The idea of repetition consists of the way the action is organized previously and not on the moment the action is actually implemented (Junior and Parrot-Dayan, 2015).

[106]Conceptual Field Theory (Vergnaud, 2009).

improvements resulting from a deliberate activity mediated through human action. Artifacts can also be understood as social historical constructions, which are culturally determined and structurally unfinished; they solve posted questions as they introduce new ones.

Rabardel (1995, 2005) refers to an instrument as an artifact that is deliberately "used" during the execution of a task, whether or not physical. The instrumentation framework is grounded on Vygotsky's ideas (1930). Rabardel clarifies that the artifact's transformation into an instrument presupposes an appropriation process, and this is the fundamental reason why it is able to mediate an action (Drijvers and Trouche, *in press*). Rabardel extends the notion of appropriation and says that instruments have a historical foundation; they can be either material, such as computers, diagrams, and maps or immaterial, such as language and schemes.

Rabardel calls this transformation process *instrumental genesis* (Rabardel 1995, 2005; Verillon and Rabardel, 1995); he explains that such genesis has a complex, compound and dynamic nature. The dynamics represent the transformation, extension, and evolution of the individual's conceptual field. He/she identifies possibilities in certain artifacts and, upon engaging with them, transforms them into instruments through a scheme of usage.

Instrumental genesis is dynamic indeed. The instrument results from the subject's action (mediation) over the artifact, and this is determined by that same action, and at the same time that it determines the action itself.

> An activity consists of acting upon an object in order to realize a goal and give concrete form to a motive. Yet the relationship between the subject and the object is not direct. It involves mediation by a third party: the instrument [...] An instrument cannot be confounded with an artifact. An artifact only becomes an instrument through the subject's activity. In this light, while an instrument is clearly a mediator between the subject and the object, it is also made up of the subject and the artifact. (Béguin and Rabardel, 2000, p.175)

Béguin and Rabardel (2000) acknowledge three types of mediation: a) *epistemic*, when the subject recognizes the object at hand and its possibilities, b) *pragmatic*, when the subject modifies and creates based on the object at hand, and

c) *heuristic*, when the subject improvises and adjusts his/her mediation through the activity.

Instrumental genesis is not trivial. It results from two phenomena: one that is manifested based on the artifact with respect to the subject, and the other emerging in the opposite direction. These processes are called *instrumentation* and *instrumentalization* (explained ahead). Instrumental genesis is also dialectic, since these two processes influence one another and actively participate in yet other processes that we can understand as *appropriation*[107] (Béguin and Rabardel, 2000).

Béguin and Rabardel (2000) believe that all instruments have two structures: a *psychological* one, which organizes the activity in itself and is related to its use; and another one, which is *specific* to the artifact being used; this one is related to its structure, its affordances[108]. These two types will constitute the subject's activity towards the artifact. As such, instrumental genesis is the evolution of an artifact into an instrument through a scheme of usage.

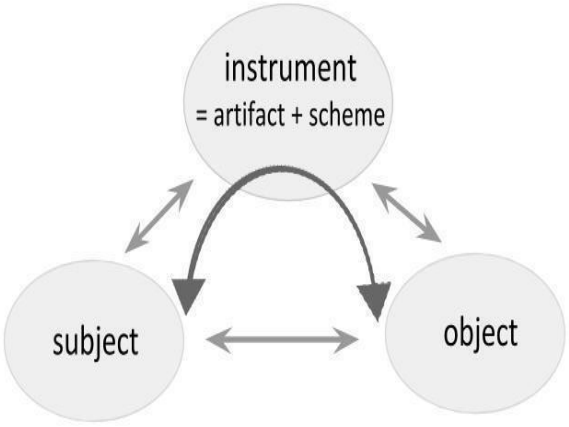
Béguin and Rabardel (2000) define *instrumentalization* as the object's evolution; it is when the operating functions of the object are established, the ones participating during the activity. In addition, they define *instrumentation* as the arising and evolution of the schemes of usage; the instrument is being built as the artefact is being used. These concepts are represented in (figures 13 and 14).

Figure 13 shows the relationship between subject and object during an action, which is planned according to a predetermined objective and mediated through instruments.

[107]We can understand this process as appropriation. When a subject identifies the artifact's possibilities and he/she uses, modifies, and applies it to a specific situation in order to solve, clarify oe improve an issue, the subject is engaged in an appropriation of the instrument's function based on his/her own personal knowledge and prior utilization schemes.

[108]Affordance theory (Gibson, 1977) states that the world is perceived not only in terms of object shapes and spatial relationships but also in terms of object possibilities for action (affordances) — perception drives action. Affordances then refer to all action possibilities depending on users' physical capabilities. For more on affordances, see Gibson, 1977.

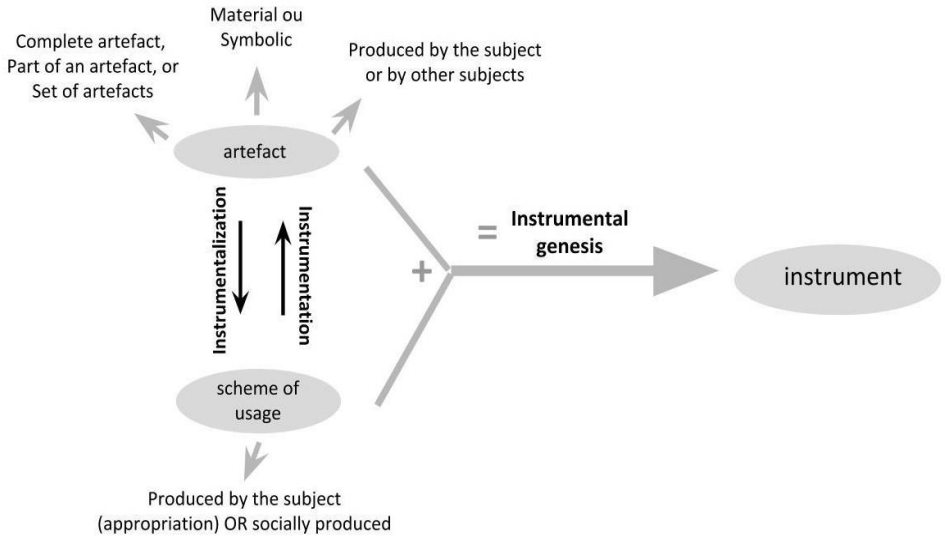
Figure 13. Instrument mediation



Source: Béguin and Rabardel (2000)

Figure 14 is more detailed on the dynamics of mediation referred to as *instrumental genesis*. The utilization scheme recognizes the artifact and its potentialities (instrumentation). The utilization (manifestation) of the artifact in a deliberate action characterizes the instrumentalization process, which somehow modifies the original utilization scheme. On the other hand, the artifact can be part of a group of other artifacts; it can also be either material (for example, a calculator) or symbolic (an algorithm to solve an equation); it can be a product of the individual, or previously produced by other agents.

Figure 14. Instrumental genesis



Source: Béguin and Rabardel (2000), extended and modified by the author.

Hakkarainen (2009) helps to understand both movements in instrumental genesis (instrumentation and instrumentalization), with the following explanation:

> A teacher who selects a technology-enhanced learning environment and designs, jointly with students (and researchers), knowledge-building projects to be pursued, has a critical role in this instrumentation process. The second stage focuses on developing and cultivating personal and collective practices needed for productively using the artifact as an instrument in knowledge-building activity. The gradual instrumentalization process takes time and depends on the involved agents' own intensive participation in the collective inquiry process. It involves a developmental process in which the instrument gradually merges or fuses in the participants' transforming activity system (p. 221).

It is throughout this process of appropriation and artifact transformation into instruments, according to many different backgrounds and situations, that the teacher reorganizes, modifies and redefines his/her prior, already-settled utilization scheme; this allows for a better understanding of the concepts used, as well as a more solid and robust performance. Instruments are cognitive entities; Bannon and Bødker (1989) alert that all actions realized through mediation involve transformation; as deliberate actions, they are built on reflection.

In conclusion, we can consider teachers as authors of epistemic instruments[109]; they mainly work with cognitive artifacts[110] and are always engaged in clarifying, knowing, and developing reasoning. According to Norman (1991), cognitive artifacts are artificial devices capable of operating, representing, and executing a specific function faster, easier, and in a more reliable manner. They are also able to change the thinking process itself.

3.4. Documental Genesis

Gueudet and Trouche (2009) use the instrumental theory framework from Rabardel[111] (1995) (described above) to develop the concept of documental genesis. The authors define documental genesis as a dynamic and continuous

[109] "Epistemic tool makers" (Sterenly, 2004).

[110] Artifacts can be practical or cognitive (Norman, 1991).

[111] See section 5 of chapter 3.

process, which results from interaction between the subject (the teacher) and the resources, bearing in mind a specific objective, the documentation work. The subject applies, modifies, evaluates, and reorganizes the available resources (material, cognitive, digital[112]) to plan and execute a didactic situation[113]. This action is contextualized; situated in space and time.

Documental genesis is the process of generating a document. By documents, we mean all the resources used in one way or another, for and in a didactic action, according to their specific schemes of use. Some examples of such resources are notes about what will be taught, the chosen material, copies of students' work, evaluation rubrics, course books, links to online material, videos about specific content or about students' work samples, records of communication, etc. It is evident that documentation work entails what is done before, during, and after the practice itself.

The schemes of usage (utilization schemes) are manifested whenever the teachers accesses their professional knowledge and act using selected resources. According to Vergnaud (1998), such schemes are regularities that "decipher" situations, concepts, relations, structures and content that are present during an acquisition process.

Gueudet and Trouche (2009) add that such regularities can be *observable* or *invisible* and that they are manifested in behaviors, habits and beliefs, during similar situations or in different contexts. For example, they are observable during an activity such as "assigning homework at the end of each class despite the group or the content being taught", considering then a similar situation (assigning homework) and different contexts (different group of students, different schools, different moments during the school year). Regularities are visible when they constitute *invariable constructs*; in other words, when they constitute the cognitive structures that will lead to those actions (for example, the belief that "doing homework improves learning").

Regularities mirror professional beliefs and influence action results that are in fact the results of the instrumentalization of the available resources (material, pedagogical, and content-related) directed at a predetermined objective. We should keep in mind that resources should be minimally flexible in order to

[112]We consider internet access as the main digital resource.

[113]For more about didactic scene, see Margolina and Rivière, 2005.

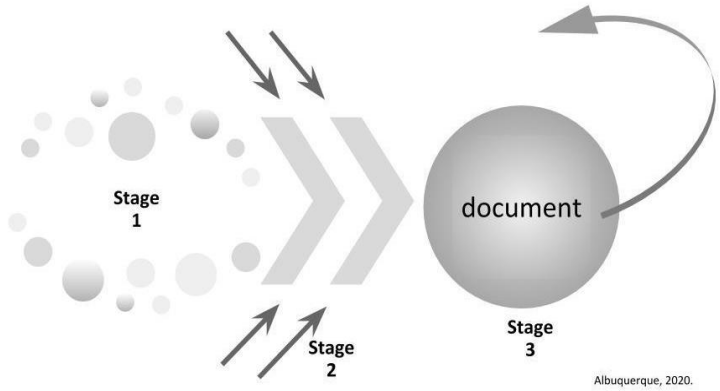
provide affordances[114]. Therefore, utilization schemes that foster documentation are a didactic decision.

Documentation work will result from the combination of resources with schemes of use that entail specific uses (flexible) and pedagogical professional beliefs (invariable operations).

Keeping in mind that documentation is continuous, deriving from a diverse interactions, and automatically feeding back into the same process over time (actions grounding following actions, one document could be a resource of another documentation process), it is understood that, as a process, it can be investigated by phases, without losing its organic aspect.

Figure 15 depicts documental work in three stages.

Figure 15. Document genesis dynamic



Source: the author

Stage 1: Inspiration - Identification - Instrumentalization

We can understand Stage 1 as the instance when the teacher is inspired because he/she is exposed to "education" as a general field, to its ideologies, and to the available resources of a historical site (schools, students, rules, curriculum, etc.). This moment entails a) identification and selection of class material, of documents, and other extra materials to be analyzed and used as resources for the practice, b) searching the web about related content (for example, in mathematics, the exploration of the *function* concept), c) participation in professional communities to discuss and share material. In fact, communities of practice are important sources for ideas, content, and inspiration (UNESCO, 1996). Délors

[114]For more information about the affordance concept, see Gibson (1977).

(UNESCO, 1996) praised the key role of local resources resulting from experiences. As he says, they are the most appropriate for facilitating realistic synergies and successful educational experiences.

This stage is also fed by the teacher's values and beliefs, and it is influenced by his/her pedagogical knowledge, his/her content knowledge and also by previous experiences (Shulman, 1986). At this point, the teacher starts to think about his/her own practice. This stage features the instrumentalization process (Rabardel, 1995); artifacts are selected according to the identification of their possibilities and the contemplation of them as important instruments for the realization of a specific action. When Margolinas and Rivière (2005) investigated the levels of a didactic situation, they identified actions and influences that happened during the implementation of an activity, prior to the corresponding classroom situation.

Stage 2: Situated planning - Structure - Adaptation

During Stage 2, planning becomes more specific, with a better definition of the activity to be conducted; instruments and teacher determine his/her action through material, cognitive and epistemological mediations; it is the genesis of schemes (Rabardel & Beguin, 2005). Teachers engage with materials available and they access their schemes of usage to identify their affordances. This stage is fed and organically influenced by external phenomena, such as motivations, skills, social environment, students' and teachers' epistemology, available resources (analogical and digital ones), the institutions' culture, field powers[115] at the time, rules, structure and the overall atmosphere of the environment in which the teacher acts, his/her public, his/her professional and personal experiences, and so on. During this stage, we see the appropriation of resources, their modification, and adaptation for a specific goal. The teacher's pedagogical decisions reflect his/her politico-pedagogical attitude and influence the intended results (Freire, 1996).

Stage 3: Documentation - Transformation - Reutilization

This is the time when a document is materialized as a summary of what was intended, selected, modified, adapted, realized and evaluated. This document

[115]For example, administrative rules, educational laws, and political constraints.

should then be criticized and revised not only at the end of the practice but also during its implementation (reflection during and about the action). This document is composed of reports, testimonies, letters, planning, messages, students' work, evaluations and their rubrics, videos and everything referring to the didactical/pedagogical process realized.

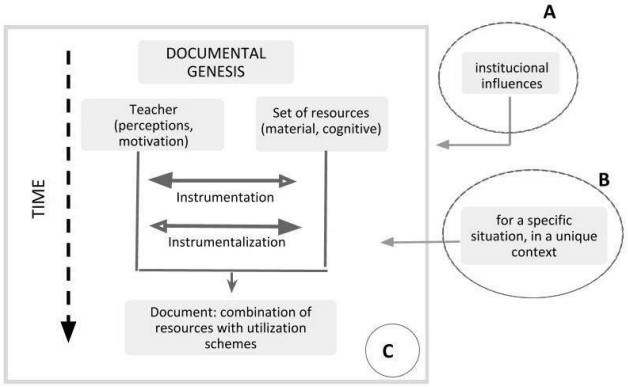
Also during Stage 3, a multitude of purposes for the document are observed; the stage self-perpetuates whenever it is reused after revisions, transformations, and proper modifications, but it is also an inspirational tool for other planning and documental genesis processes as well. When the document is involved in other processes, it is considered an instrument for the genesis of other documents, participating then in stages 1 and 2 of the other documentation genesis processes[116].

Language is manifested here. Even though the teacher's records, whether authentic or remixed, need a minimal structure compliant with language rules, it is undeniable that orality is present because the documents also contemplate productions and informal dialogues, which represent the context from which the resources were applied and how they were used during the pedagogical process (Marcuschi, 1997).

Gueudet and Trouche (2009) apply instrumentation and instrumentalization concepts, as developed by Rabardel (1995, 2005), and the utilization schemes by Vergnaud (1998) to build the concept of documental genesis. The scheme of such a concept is represented in figure 16.

Figure 16. Documental genesis process

Source:



Gueudet and Trouche (2009), modified by the author.

[116]Shulman (1986, 1992) talks about the importance of case studies in teacher training courses. More specifically, he talks about how the practice of an "outstanding" teacher can and should be accessed by other professionals outside his/her classroom where such practice indeed took place.

Structure A relates to stage 1 from figure 15, structure B to stage 2, and structure C to stage 3, which is the documentation work itself.

According to Gueudet and Trouche (2009), the genesis of documentation work is not only a strategy and a tool to investigate and examine pedagogical practice realized through the application of cognitive and metacognitive processes. For them, it is a powerful instrument to make the work of teachers visible.

Lim (2016) agrees with these authors when she says that such teacher documentation creates curriculum material, helps better define the activities implemented and the ones to be implemented, integrates new materials, and inspires practice, knowledge, attitude, and belief changes. In this sense, documentation constitutes professional activity itself, being fundamental to support changes and welcome improvements to the teaching and learning process. The documents do not describe tacit knowledge and, surely, they are not a manual with instructions, but offer pieces of evidence, memories, and examples.

Campos and Diniz (2003) emphasize the value of deliberate actions devoted to the development of reflective practice, which do not happen spontaneously. The literature considers documentation as one of these actions (Ball and Cohen, 1999; Gontijo, 2011; Neuenfeldt et al., 2014; Lim, 2016).

3.5. Relating the four concepts

The processes conceptualized here are related as shown in Figure 17. In fact, their intertwined interactions guarantee dynamism to the process of documental work.

By investigating each element once at a time, we can make some inferences, and understand how each one can be seen as a factor strongly related to the others.

Activity theory grounds instrumentation genesis and this last one explains the process of documental genesis. The relationship between documentation work and reflection is our focus in this work.

Activity Theory

Activity Theory grounds the interaction between technical resources. In this sense, *reflection* presumes deliberate action; both *instrumentation* and

instrumentalization processes result from a mediation that transforms instruments into pedagogical resources (instrumental genesis as defined by Rabardel, 1995, 2001), and *documentation* becomes a manifestation of enactive and extended situated cognition.

Reflection

Critical reflection can improve practice as teachers revises their performance, questioning goals and objectives, and learning outcomes. Also, according to their personal and professional habits and beliefs, teachers rethink their role as educators. Reflective behavior is manifested when a teacher *documents* his/her practice, these being not only the materials and resources accessed during teaching and learning process, but also the corresponding schemes of usage[117]. *Reflection* is also manifested during instrumental genesis as a teacher interacts and deliberately decides about the resources participating in his/her pedagogical scene.

Documentation

Documentation helps the *reflection* process, as it is an *instrument* for recording manifestations of pedagogical work, such as learning outcomes, assessments, schemes of usage[118], and students' work, etc. It develops reflection through *interaction* between a subject (teacher) and socio-material environment.

Instrumentation and Instrumentalization

Based on Rabardel's work, instrumental genesis requires a process of appropriation, which allows the object to "mediate" the *activity* (Drijvers and Trouche, in press). In fact, as part of it, the instrumentation genesis is manifested when pedagogical resources are documented and registered with the use of digital technology, and also when the act of documenting resources and schemes of usage modifies the resources themselves as well as the teacher's practices and the environment in which the action takes place (Rabardel, 2002).

Besides the existing link between the 4 main concepts adopted and investigated in this work, attention should be given to the potentialities of digital technology.

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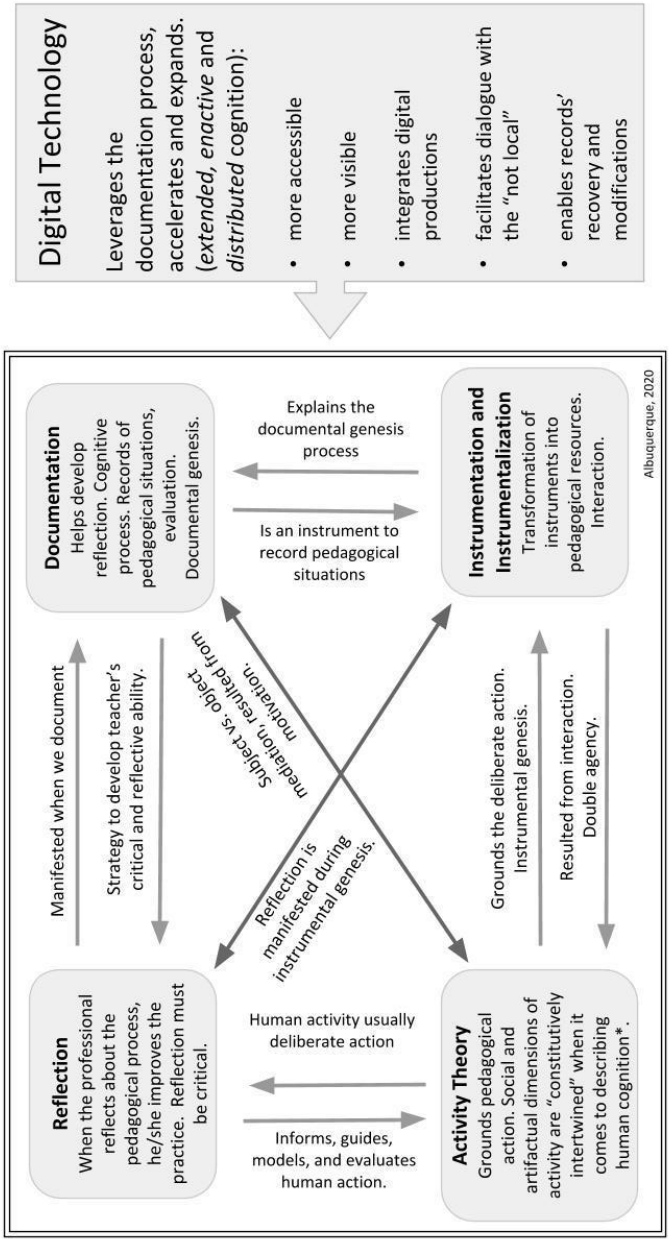
[117] See Rabardel and Beguin (2005, p. 439).

[118] See Rabardel and Beguin (2005, p. 439).

Digital technology is a significant factor for the acceleration and expansion of the documentation process and all that it entails, thereby granting more accessibility and visibility to the documents, allowing the integration of digital productions, and facilitating dialogue with the “not local”.

Digital technology can empower teachers’ documentation and re-signifies the relevance of such practice.

Figure 17. Connecting the concepts



Source: the author

3.6.
Instruments and documents

We have already recognized Ghislaine Gueudet and Luc Trouche as two of the main researchers on documental genesis (Gueudet, Trouche et al. 2009a, 2009b, 2012, 2013, 2016); the authors clarify that instrumental engagement happens as a document is constituted and also identify the institutional, social and personal influences on the process of recognition and use of available resources. This use happens through the application of schemes of usage based on the individual's conceptual fields, as addressed by Vergnaud (1998, 2009).

Other studies also investigate the dynamics and the importance of teaching documentation work (Lim, 2016; Peaslee et al., 2007), as they recognize teaching practice as a legitimate and authentic setting for professional knowledge development (Chevallard, 1991; Shulman, 1986, Ball et al., 1999, 2008). Shulman (1986) and Ball et al. (1999, 2008) emphasize pedagogical content knowledge (PCK) as the knowledge that is constituted in practice and results from three main variables: knowledge about the content to be taught, knowledge about pedagogical practices and didactics, and the context in which teaching and learning will take place[119]. These authors reinforce that such knowledge can only originate during the activity of teaching because it is situated and historically determined. Shulman (1986) goes further and describes such activity, teaching activity inside a classroom, as a lonely practice, as most of the time it is a closed spectacle, undisclosed for appreciation or evaluation by others, such as being exposed to reviews by peers. In this sense, documentation appears as a possibility for the registration of such fundamental knowledge, allowing sharing and discussions at some point in time.

3.7.
Digital instruments constituted as cognitive technological resources

When Rabardel and others (Rabardel, 1995, 2002; Verillon and Rabardel, 1995; Rabardel and Samurçay, 2001; Rabardel and Bourmaud, 2003) explore the nature of the material of cognitive instruments and their participation in pedagogical processes, they investigate the central elements of instrumental

[119]Didactic situation by Margolina (1995, 2002).

genesis and extend their investigation to contemplate digital aspects. In fact, Verillon and Rabardel (1995, 2001), and also Béguin (2000, 2001) acknowledge that digital technology contributes with more complex and non-trivial instruments to the pedagogical process. As a matter of fact, these authors consider such instruments as "anthropocentric", as their scheme of usage is determined at the same time as they determine their usage by the agent, in this case, the teacher.

According to this line of thought, we can consider the use of computers for documenting pedagogical practices as an innovation, as their use facilitates the documentation process, thereby creating new demands and possibilities in their course and extending and broadening the instrument's utilization scheme. We can also assert that the use of networked computers interferes and reframes the conceptual field (Vergnaud, 2009) of the specific activity named "to document".

Sorensen (2009) goes further and claims that learning is a socio-material achievement. She draws attention to material agency and to the outcomes in the form of patterns when agents engage in a performance together; in our case, teachers and computers.

We can now make a remark about the relationship between the loneliness of the teaching profession, the knowledge that emerges from practice, and the digital documentation process. As a teacher digitally documents his/her didactic scene with all that it entails, he/she gives vitality and strength to the practices, enabling them to be appreciated and referred to by other professionals. Digital documentation can also enable and facilitate the constitution of a community of practice (Sheridan et al., 2009), as part of which efficient, creative and inspiring performances are more easily studied, copied, modified, and re-signified.

Digital technology changes[120] the way we think about phenomena and relations in general, for example extending our memory and the ability to work with big data; it changes the way people get to know and communicate about things (Castells, 1996; Hill, 2001). In fact, digital technology allows new ways of social organization that transcend time and space. In this sense, we can apply to the web, and to the products constituted through digital technology, the idea of "net" as defined in Capra (2006), which relates to a more holistic approach, acknowledging a dimension that is cognitive, biological and social. As such,

[120]We are considering mobile technologies such as computers and cellular phones.

digital documentation can connect professionals, allowing their practices to outreach and influence other practices (Castells, 1996; Pischetola, 2016).

The idea of a "web" is also associated with the idea of communities of practice, now active and interrelated. Solomon (1993) relies on digital technology to talk about distributed knowledge, as it is constituted inside a system that includes the individual himself, his/her peers, other teachers, and a myriad of tools and cultural instruments (p. 112).

We investigate if digital technology enhances not only the documentation process but also the processes of reflection, collaboration, and sharing. Pischetola (2016) points out, however, that the existence of digital instruments does not guarantee their use or their appropriation. The author reminds us that possibility and availability do not ensure proactive attitudes. The opportunity to use digital resources in the documentation process and for the collaborative construction of knowledge will depend upon the individual's oriented motivation, and also on his/her effort to create schemes of use that afford the use of such resources for these specific objectives. These aspects are fundamental for enabling the development of a net able to connect different people who live apart, to expose new talents, and to discover and to use authentic knowledge being produced in specific areas (Martinho, 2003).

Use of digital resources in both didactic situations and teacher's critical documentation processes points to a practice that is reflective and susceptible to consideration, sharing, and use. This allows the development and improvement of legitimate professional knowledge, which constitutes good *praxis*.

4
PROPOSED STUDY AND THE STRUCTURE OF INVESTIGATION

"I have been impressed with the urgency of doing.
Knowing is not enough; we must apply.
Being willing is not enough; we must do."
Leonardo da Vinci

4.1.
Study proposal

We live in a moving, connected society, with multiple opportunities to seek knowledge; we call it a "learning society" in which the learning is "global". Not surprisingly, because of this, there are huge consequences for schools, teachers and students, and education in general (Castells, 1996, Pischetola, 2016). In a world that is increasingly more complex, it is imperative to develop autonomy, communicate with clarity, have logical reasoning, work collaboratively, organize the work to be done, have discipline, be active in one's own knowledge development, be open to new learning, and know how to seek valid information; in other words, it is imperative to relate knowledge with both practice and personal and professional skills.

It is hard to determine the beginning of the teaching and learning processes, but the existence of a multitude of ways, formats, environments, situations, circumstances, objects, and agents that have constituted these dynamics through time is clear enough. On the one hand, such practices have been widely documented and shared through the broader use of digital technologies (in lesson plans, class activities, and the use of resources, etc.). On the other, nonetheless, the parameters for this documentation and the analysis of what happens after the teaching-learning moment have not been documented enough.

The main objective of this work is look for a relationship between documental genesis and reflective practices; we investigate the existence and the configuration of the work of teachers who not only execute the practices planned, but also document and reflect upon them. In addition we seek indicators that digital technology facilitates, motivates and helps to reproduce the documentation of teaching work. The belief that reflection triggers a metacognitive process

grounds our study. Whenever a professional critically reflects, he/she reconsiders his/her actions, thereby reevaluating, resizing and reforming their practices, always conscious about his/her limitations and cultural, historical, and social constraints; this process can only improve practices and develop better ones (Gueudet and Trouche, 2009a, 2009b, 2009c, 2012; Gueudet et al. 2013).

The investigation focuses on middle school teacher digital documentation work as a fertile ground for thinking and critically reflecting on practices, embracing innovative methodologies, and processing transformation. Actually, documenting only makes sense if its outcome is legitimate, useful, alive, and if "change" is part of the intrinsic motivation that gives rise to the process.

4.2. The relevance of this study

In 2001, Russell and colleagues (2003) conducted research in Massachusetts, U.S.A., from 2001 until 2004, in which they gathered data from 120 district-level administrators, 122 principals, 4,400 teachers, and 14,200 students to examine teacher technology use and the implications for pre-service and in-service teacher preparation. After analyzing the use of technology for instructional purposes in and out of classrooms and its correlation with the teachers' years of professional experience, the authors concluded that technology (computers) was much more used for preparation and communication than for planning differentiated instruction and activities that involved technology. In their investigation the authors proposed six categories to investigate teacher practice and to help model teacher training.

The categories were:

a) teacher use of technology for preparation,
b) teacher use of technology for delivery,
c) teacher-directed student use of technology,
d) teacher use of technology for special education and accommodation,
e) teacher use of e-mail,
f) teacher use of technology for recording grades.

In 2018 Brasilino et al. conducted a quantitative study aimed at some similar objectives. The authors investigated digital literacy, more specifically the

consequences of both the introduction of digital technological equipment in schools and the offering of ongoing ICT courses concerning technology integration in teaching activities. The study was based on data from the *ICT in Education 2014 Survey*[121] and involved 930 schools (623 public) and 1770 teachers. The correlation between the latent variables of "specific ICT training" of teachers (institutionalized and informal) and of "pedagogical use of ICT" by teachers (dependent variable) considered, as did Russell et al. (2003), different and diverse aspects for the use of ICT, such as class preparation, content research, use of ready-made presentations, search for examples and materials production (texts, spreadsheets, etc.).

We can say that in our study some of these perspectives are broadened, taking similar goals as a starting point. Our investigation approaches yet another use of technology by teachers: its use for digitally documenting their practices (although we will consider that their documentation work would consist also of pieces of communication (emails), preparations for class, tables and graphs with students' results, and so forth). We agree that concepts concerning this theme are not very clear, and sometimes can be misleading (see Russell et al., 2003, p.300); for example, in our case, we could question what reflective documentation is, and how documentation is defined. Our focus is less on learning, and more on teaching practice in all its dimensions, and on the visibility of that process. Of course, we are well aware that teaching and learning compose the same phenomena; they generate and determine each other.

Our intention is that our investigation prove itself relevant. The data will reflect more than 80 public schools in all the eleven education districts in the city of Rio de Janeiro. Through questionnaires, focus group and semi-structured interviews, we will look for data about a) the adaptations made before pedagogical action due to peculiarities related to population and settings, b) examples and samples of the pedagogical documentation c) the physical and the structural limitations to practice, d) the approaches used in the pedagogical process in general that can relate to documentation work.

We suspect and suggest (and are trying to find strong correlations about) that the pedagogical documental genesis, when facilitated by digital media, can

[121]Brazilian internet Steering Committee (CGI.br) (2015). Survey on the use of information and communication technologies in Brazilian schools: ICT in education. São Paulo: CGI.br.

involve reflection, and consequently, be able to extend and develop cognition, informing not only practices and their improvement, but also serving as inspiration for other practices.

This work uses regional data (City of Rio de Janeiro), and it aims at providing illustrations of digital practices being documented and that are suitable for professional reflection, besides allowing comparative work among teachers' practices in general.

Our investigation will be broken down into three phases. First, we will seek to find, with the analysis of a survey given to a diverse population of public middle school teachers from the city of Rio de Janeiro, indicators that they document their practices, and that they recognize not only the importance of doing so, but also the reflective component in it. In a second phase, one focus group will aim to clarify teachers' ideas about the grounds and potentialities of reflective practice and how documentation work can influence and facilitate transformation and innovation in practices. Lastly, individual interviews gather data about motivations, uses, applications of teachers' documentation work as well as samples about how such work is organized and revisited.

We are assuming that reflective documentation is an essential feature for professional development, and also for the establishment of a pedagogical process that is indeed liberating, critical, flexible, and that corresponds to legitimate and situated practices, designed to attend to specific social demands.

If it is true that teachers who document their practices with the help of digital technology actually reflect during this process, and by so doing, increase their self-confidence about their abilities as professionals, then we could look more closely at such practices, and also expand our reflection about how the material is documented, shared, modified, and reused.

However, if we find that digital media are used mainly superficially and focused on the reporting of final products rather than on the production of materials to be analyzed and reviewed to fulfill their potentialities such as transformation into pedagogical content, then we should be asking ourselves "why" and "how" such material, that is, real, authentic, informative, and fertile material does not transcend the "showcase" function into "material to be reflected on" mode.

Only through an investigation on teachers' motivation to document, on the existence of documented material, and on the perception of its importance, will we be able to outline how (and if) reflection participates and is part of the documentation work, and also how (and if) we can consider it a fundamental component for best practices.

Education benefits when there are attempts (and even more when there are real accomplishments) at comprehending with clarity not only teaching practice and how a teacher relates to the student during the process of documentation, including assessment of learning and registration of routines, but also what their objectives as a professional are.

Nóvoa (2009) argues that, to think of quality education which produces authentic critical knowledge implies that the professionals involved in that process reflect upon what they intend and plan to do, and what they actually put into practice. Not only the use of the available and efficient resources that facilitate reflection and improve and develop cognition should be part of practice, but also the use of such tools that help review the processes, scrutinize the choices made and the results obtained by professionals in a similar field of practice and, lastly, project the practices realized to other universes[122], other contexts, other situations, and with other target audiences.

Délors (UNESCO, 1996) draws attention to the importance of the appropriation of available resources. The ability to select, collect, organize, manage and use different resources stimulates the documentation of practices, which fosters the ability and willingness to learn continuously, by which we can assume an improvement of practice, and a more general development of a "learning society". In fact, the professional abilities endorsed by UNESCO's report (1996) are the ones that encourage the development of those communities of practice, what Shulman (1986) defends as a vital condition for the development of authentic, meaningful, and efficient pedagogical content knowledge (PCK), and also as an efficient force for minimizing the distance between theoretical and pedagogical knowledge. Shulman (1986) refers to this distance as the "missing paradigm".

[122] According to Chevallard (1999, p. 229), a punctual praxeology has the potential to affect local, regional organizations, and so forth.

This study is relevant because it strives to find, in documentation genesis, traces that the teacher's practice is reflective, which would characterize the teacher as a professional who builds knowledge, and modifies and improves his/her pedagogical activity each and every time. The acknowledgment that the material produced is legitimate, and true to the circumstances in which it was generated, invites and encourages the use of such material to discuss teaching practices, besides being suitable material to be included in teaching courses.

4.3. The nature of the investigation

As this study investigates a social, subjective practice (teacher documentation), manifested in a complex, situated, and challenging environment, a qualitative[123] approach will be adopted in order to explore: a) how and with which motivation the documents are constituted, b) what are the purposes of such documents, and c) to what extent[124] the practices documented can be called reflective.

Based on the information made available by the participants, the main goal is to verify that documental genesis entails teacher's reflection about the teaching work (as a reflective act, it can be considered as an instrument to improve practice).

Specifically, the objective is, along with the participants, to understand documental genesis work, the activity and the action that originates and constitutes it as a reflective and cognitive process.

This qualitative research intends to investigate teacher documentation work, its content and its aspects in all possible dimensions (motivation, goals, beliefs, attitudes, outcomes, etc.).

According to Habermas (1971, p. 309-311), the value of knowledge is founded basically on three main cognitive interests: to predict and to control, to comprehend and interpret, and to liberate and emancipate. When referring to teaching documentation practice, the goal is that the records transcend the first two interests and reach the third one. These records should serve for more than

[123]Despite its qualitative aspect, we will calculate some percentages in order to review and understand questionnaire results and patterns better.
[124]According to classification and considerations made in Table 1.

just controlling and comprehending what has happened during the didactic scene; they should manifest a *praxis* that has been thought about, reflected upon and modified according to the situation where it was carried through; they should reflect the practice that was intended to develop students' critical ability. Indeed, as Paulo Freire (1996) affirms, teacher's critical reflection presumes a commitment with a cognitive emancipatory process. This reflection not only describes the pedagogical scene but has interpreted it; it seeks to distinguish the reasons behind such action, its causes, and its effects. Reflections and evaluations during the whole process promote modifications and yield improvements in practices.

Smyth (1989) summarizes reflective practice in 4 stages: a) to describe (What did I do?), b) to inform (What did it represent?), c) to confront (How did it happen?), and d) to rebuild (How can I make it different next time?).

Based on this proposal, we will use qualitative methodology to investigate teachers' perception about their documentation work, the content being documented by them, how it is related to the didactic scene that feeds and constitutes the content for the documentation.

According to the qualitative method, the participants in our study were selected in two moments, as described in the following section.

4.4. The structure of the investigation

The study sought to use the data available at the Rioeduca site, a public site belonging to the city's education department[125], to identify schools where teachers' documentation practices were visible and available and, based on this, reach these professionals to compose the population for the study. Because of our intended interaction with the teachers, we had to get permission[126] from the university's Ethics Council[127]. Only after this approval were we able to contact the City Hall's Education Department to apply for their permission to contact and visit the schools and interact with teachers and administrators. This specific

[125]Prefeitura do Rio de Janeiro - Rioeduca: http://prefeitura.rio/web/rioeduca

[126]See appendix 5 (Portuguese) and appendix 6 (English).

[127]To get permission, I had to detail my investigation, explaining my motivations, my planned actions, and the way that I would be interacting with the teachers.

permission (one for each of the 11 educational districts) took about 4 months to be approved, and on August 2018, we had a one-year permit in our hands[128].

We structured the research in five steps: 1) retrieving the pertinent legal permissions, 2) visiting schools and contacting teachers, 3) gathering data through a questionnaire and also through a focus group to narrow down possible conclusions, 4) contacting teachers willing to and available for an interview at their workplace to gather more detailed information about their motivation and documentation practice, and 5) analyzing data using Excel software to organize answers and correlate results using bivariate statistics as well as Atlas.ti software for content analysis.

The structure of the study comprises the definition of the population (subjects), the instruments for collecting and analyzing the data (method), the data analysis (chapter 5), the discussion (chapter 6), and the conclusion (chapter 7).

4.4.1
Subjects

In order to avoid biases in the participants' selection, our first attempt to get the data was to use the contacts provided by the GITE[129] department at the City Hall of Rio de Janeiro. We looked for an institutional channel that could reach all the city's public middle school teachers, without any predetermined subjective selection. The goal was to reach teachers from all educational districts using social media to send a standard message, explaining and inviting them to participate in the research through an online survey. Meanwhile, we made an inventory of all the inputs on the Education District's public website, Rioeduca[130], over more than a 4-year period, focusing on the teachers and schools that used institutional media to display and disseminate relevant teaching practices[131]. This inventory was compiled with entries from January 2014 until March 2018. We read 2,294

[128] See appendix 7.

[129] GITE - Gerência de Inovação e Tecnologia Educacional is a department that deals with technology and innovation in education. It operates inside the City Hall of Rio de Janeiro. By that time (2018), the coordinator Gisele was the one responsible for forwarding my message and invitation to the teachers.

[130] www.rioeduca.org

[131] Focus only on the entries about middle schools' practices.

inputs[132] and selected 165 schools that had one or more records entered by middle school teachers (see appendix 9). We discarded those concerning school festivities or the ones not specifically from middle school grades. Our intention was to identify schools and respective teachers who matched the ones that answered the social media invitation. We expected many answers through digital messages, and matching would function as a selection filter. The plan was to visit such schools, meet with the teachers, observe their documentation work, and invite them to the following phases of focus group and semi-structured interviews.

Both strategies proved to be inefficient. The GITE's channels of communication were ineffective for receiving an acceptable number of responses, and the inventory turned out to be unreliable. We suspected that the real motivations and attitudes behind these inputs were not revealed and we were also not sure if the publications were voluntary and open to all teachers.

We decided to change strategies and sought a longer but more assertive path. With the one-year permission from the Education Department in hand, we decided to meet directly with each School District Representative (CREs[133] [134]). All 11 districts, which cover an area of about 1,255 km^2 (about 780 mi^2), were visited, and we obtained a second, more detailed permission, from each one of the CREs to finally be able to visit any of their many school units[135]. The City of Rio has about 39,000 teachers and more than 645,000 students; about 1,550 operating schools units, and more than 800 of these offering middle school grades[136].

Going back to the start, we needed to select a population for the study applying a strong and unbiased procedure. The ultimate selection of schools and teachers who constituted our population was then threefold.

First, with the intention to maintain diversity, we visited each and all of the 11 educational regions (CREs). All of the CREs have a specific educational department that deals with external research addressed to schools and teachers called *Gerência de Educação*[137] (GED). During 3 weeks, between November and

[132]During this process, we disregarded the registrations about: a) lower school projects, as we will focus on middle level practices; b) festivities and commemorations such as school's birthday, because they do not represent a didactic scene for a specific teacher.

[133]CRE - "Coordenadoria Regional de Educação".

[134]List of CREs coordinators and their main information in Appendix 4

[135]Sample of one of these documents in Appendix 8.

[136]http://www.rio.rj.gov.br

[137]GED - Education Administration Office (Gerência de Educação) - specific division of each CRE.

December of 2018, we met with each GED coordinator to explain our study and the restraints concerning our targeted teachers: *middle school teachers who somehow use digital media to document their practices*. During the meeting, we also tried to obtain some information about which schools to go to, and how to approach teachers and administration. Their recommendation considered the commitment of the schools' administration, and also the school academic performance based on IDEB[138]. At that time, it was agreed that schools inside challenging communities and "at risk" places such as *favelas* would be avoided for safety reasons. The GEDs used different procedures to draft the permission; some made a 10-12 schools list with the recommended ones, others printed out the list of all their schools and pinpointed the ones that they encouraged us to visit, and yet others just gave us general permission to visit any school we thought appropriate.

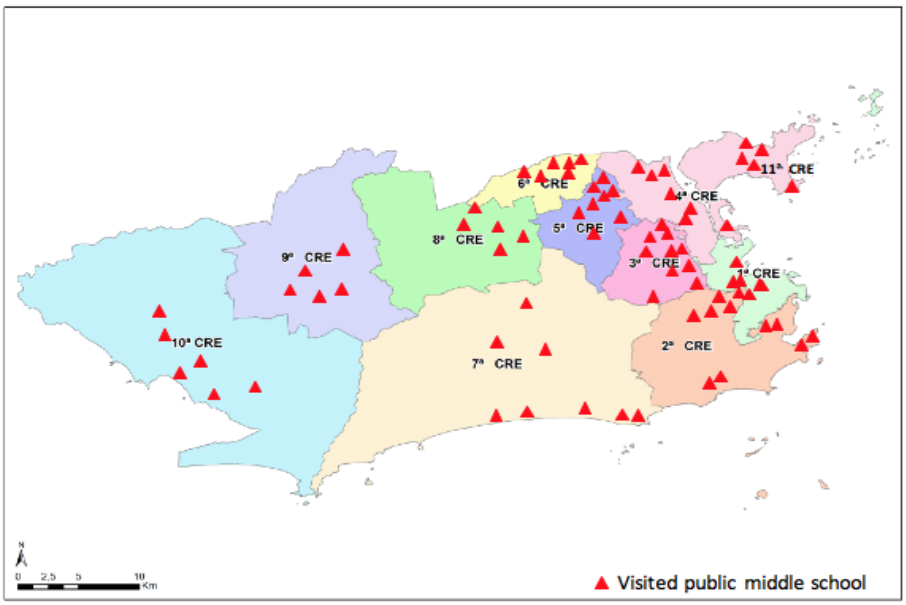
Second, with both permissions (from both SME[139] and GED) in hand, and an idea about the schools to be visited, we applied another filter that focused on their official performance (IDEB index[140]), and also on the existence of a minimal infrastructure such as internet[141] and computers, available to be used by teachers and students. We understood that better school performance could be related to important and meaningful factors for our research such as teacher's assiduity; communicative, proactive and collaborative professionals who are more willing to, and in fact use, documentation practices; and a positive environment that we could benefit from when seeking information. We also believed that a better infrastructure concerning computers and the internet most likely would be an important element for facilitating and fostering digital documentation.

With about 12 middle schools selected in each of the 11 school districts (about 130 schools), our third filter was based on logistics and dealt with distances, locations and time constraints. We used Google Maps[142] to calculate distances and alternative routes. To visit some groups of schools, for example, we needed to travel up to 190 km (about 120 mi) in a one-day round trip.

[138]For more information about this evaluation index, see http://inep.gov.br/ideb
[139]SME - "Secretaria Municipal de Educação" (Municipal Secretariat of the city of Rio de Janeiro).
[140]For more information about this evaluation index, see http://inep.gov.br/ideb
[141]Data available at https://www.qedu.org.br
[142]https://www.google.com.br/maps

We planned to visit one CRE per day and about 6 to 8 schools, depending on the access to teachers in each institution. In total, we visited 80 middle schools (see figure 18).

Figure 18. Distribution of the visited public middle schools in the 11 school districts – City of Rio de Janeiro



Source: SME (2001)

Prior to each day in the field, we made sure to carry all the information organized in our notepad as shown in the model below (see figure 19); the schools were listed in the order of the planned visit, and the list had more schools than could fit in one day, as we expected to find difficulties such as "unfriendly" administration, very busy or absent teachers, or even closed units.

Figure 19. Field notepad

CRE: _____

	BEFORE THE	VISIT		AFTER THE	VISIT	
name of the school	address, phone, email	name of director and pedagogical coordinator	indexes: IDEB and effective learning	name and other information about prospective participants	observations about receptiveness to the study	further actions

At first, we spent one whole day covering each CRE (in a total of 11) and managed to talk to or get references for more than 200 teachers who fit our profile - middle school teachers who somehow used digital documentation in their

practices (intentional sampling). When talking/searching/inviting the teachers, we clarified some fundamental aspects and conditions for being a participant, since our research had a specific focus of study. The prospective participants were required to have/show: a) documentation practices using digital resources, b) a perception that their documentation involved reflection, c) availability to participate in the investigation (answering the survey, showing samples of documents and participating in the focus group), and d) intrinsic motivation to document their own practices; their documentation should not be a result of administrative demands and political pressure.

On the first visits, we offered printed versions of the questionnaire, so teachers would have the option to complete it in writing or electronically. However, after meeting with a statistics professional to discuss methods to prepare and interpret the data, he encouraged us not to use diverse ways to gather data if they do not present exactly the same layout and order for the questions (they were indeed slightly different because of software limitations) in order to avoid bias. After that, we contacted the ones who had already answered the survey in writing, and asked them to do it again, but digitally. In the end, we had 78 valid responses to be analyzed. The data was read and grouped using Excel and compiled as a report for easier overview. Our analysis considered simple univariate variables as well as bivariate analysis. The analysis was then supported by open questions and answers, as well as by the focus group interpretation and transcription and categorization of semi-structured interviews.

4.4.2. Method

A measuring instrument is a method used to gather data, the varied forms of information obtained from the participants. The validity of the method leads to the achievement of reliable and authentic data, which is fundamental for any desired meaningful conclusion. We used a hybrid method; despite our lack of numerical primary data, we calculated some percentages to look for patterns and trends in the data collected by the survey.

We decided to gather our own data (primary data), which was collected on three occasions. First, we administered an online questionnaire to investigate certain demographic information as well as professional habits and beliefs related

to the use of technology and also to teaching practices. Based on the answers and the teachers' willingness and availability to meet and discuss in more depth the topics being addressed, we then conducted one focus group and 12 semi-structured interviews.

We believed that the questionnaire, together with the focus group and the interviews would lead to finding trends, patterns, motivations, and perspectives, besides establishing relations that could facilitate thinking about the pedagogical process of a teacher's disposition to organize and document her/his practice. Bogdan and Biklen (1984) say that data analysis is the moment when we organize all the material in order to comprehend the phenomena being studied. It is the moment we look for these patterns, thereby investigating relations and tendencies.

We used grounded theory to elucidate the qualitative methodology; the theory was developed based on the data collected and its subsequent systematic and comparative analysis. Grounded theory is suitable for working with qualitative data, thereby providing ways to conceptualize with the objective of describing and explaining. We established conceptual categories based on our theoretical framework; the analytical categories emerged from the data and were processed as the analysis took place. In accordance with Grounded Theory directives, the focus group and interviews were transcribed in their entirety so that we could properly start the following step of discovering the categories (open codification) to just then start the grouping of the categories in more central and relevant ones.

Below we detail the instruments used to collect our primary data.

Questionnaire[143]

This is perhaps the most common instrument to collect individual data from participants (sample or population). Questionnaires are anonymous, cheap to administer, can collect data from a large number of people in basically a short period of time. However, these advantages go hand in hand with some complexity. No study is better than its questionnaire; it should not have faulty or biased questions and there is the basic concern that the questions must be easy to understand, not wordy and not too long (Bogdan and Biklen, 1994; Cohen, Manion and Morrison, 2000; Gillham, 2007).

[143] Attached in Appendix 11.

After defining our population, we narrowed down the topics to be investigated. The idea was to build a questionnaire that offered enough data to find meaningful results and tendencies. The questionnaire was put together using friendly software (*SurveyMonkey*), had 36 questions and was expected to be completed in less than 20 minutes. It had three sections; one focused on identification variables such as age, years of experience, grades being taught, etc.; the other investigated practices and attitudes related to documentation that could indicate reflective behavior; and the last was the only one with open questions, which referred to their belief about the relationship between documentation, reflective behavior, and improvement of practices.

Reliability, validity, and meaningfulness were considered when designing the questions. We discussed ordering, content, and wording with partners and advisors; we also administered a pilot version with colleagues. We avoided creating questions that might foster ambiguous answers, and we were careful with the text to prevent the teachers from being induced to choose one answer instead of another. The questions were detailed and specific, so bivariate analysis would indicate reliable tendencies.

We visited one administrative area per day and the visits usually occurred between 8 AM and 7 PM. When inside the schools we had to refer to the administrative office to explain the study, showing both official documents (one from SME and the other from CRE/GED). Right after that, and depending on receptiveness, we were allowed to talk to the teachers. The meetings, usually during their recess or lunch hours, were inside the teachers' room or just outside a classroom while they were teaching. If it was not possible to talk to a prospective teacher (indicated by the administration or by colleagues), we contacted them afterwards, sending the pertinent information and the attached survey link by email.

During a school visit, we got the chance to better explain the motives, objectives, and goals of the work being done. On the same day after the school visits, emails and phone messages were sent with an extra explanation of the study (already discussed during the visit to the schools) and the link to the survey. The emails were personalized and carried specific personal information about professional details shared during the school visit. The intention was to encourage teachers who each and everyone's participation was very important, and also that

the reason for visiting all 11 regions was to reveal practices applied in very diverse, but at the same time similar, conditions, as they were supposed to represent critical reflective digital documentation processes.

The visits were carried out in the first half of December 2018, just before the end of the school year; we could argue that this was both good and bad timing. The teachers were tired and busy with grades, final exams, and comments; but they were also not involved in planning and teaching regular classes anymore. Overall, they were very receptive and willing to participate and collaborate. Besides answering the questionnaire, 45 teachers (about 58%) said that they were interested in participating in interviews and focus groups.

At the start of the new school year (February, 2019), we decided to remind administrators and teachers of our research and online survey. We sent individual reminders to all 11 CREs, and also to all teachers. After this additional effort, we only received 6 new replies.

The survey was closed in March 2019 and the analysis started then. We used the support of a statistics professional to transfer, organize and prepare the data using Excel software. After a first analysis of the raw data, we decided which bivariate statistics would be calculated. The main correlations were between age, years of teaching, and content taught, with teaching practices, integration of technology into their practices, and reflective behavior.

After the analysis of the data gathered through the questionnaire with closed and opened questions, a focus group was planned to proceed with the investigation.

Focus Group144

Focus groups are a type of in-depth interview to obtain data from a group of people at the same time (Freitas et al., 1988). Its use started in sociology but was then expanded to other areas, such as education. Focus groups concentrate on a clear and defined topic, and on the homogeneity of participants, as the objective is their interaction inside the group.

Kitzinger (1995) defends that focus groups benefit from communication between the interviewer and the participants to generate relevant data. During the sessions, the participants should be encouraged to talk among themselves, thereby

[144] Attached on appendix 12.

sharing ideas, past experiences and commenting on practices used by other participants. The author also affirms that this method is efficient in exposing *what* the participants think and believe about the subject being discussed, and also *why* they think that way. It is presumed that the participants have had experiences about the topic being addressed, so that their participation brings meaningful, real, and authentic data to the discussion (Gatti, 2005). Participants influence each other through their answers and their overall contributions about the predetermined topic; for that reason, there should be no constraints on their active and easy participation, such as the presence of a superior, or an intimidating atmosphere (Freitas et al., 1988).

Trad (2009) adds that focus groups enable collective reflection and are valued for the reliability of the conclusions. According to Freitas et al. (1988), focus groups are used for "generating ideas for investigation or action in new fields; for generating hypotheses based on the perception of the participants; to evaluate different research situations or study populations (...); to supply interpretations of the participants' results from initial studies; and for generating additional information for a study on a wide scale (p. 2)."

For this aim, we need to be aware of the pros and cons of using such a method. Focus groups allow you to generate and explore hypotheses, are not expensive, have high "face validity", and allow you to collect interesting data from group interaction, such as beliefs, opinions, views, values and experiences (Eaton and Brown, 2017), thereby "contributing to a stronger conviction on the part of the researcher" (Freitas et al., 1988, p.5).

On the other hand, despite the atmosphere of a focus group not being natural (teachers' workplace), it ought to facilitate dialogue; in addition, the researcher has less control over the data that is being generated, and its analysis is not easily carried out.

Our goal was to use the Focus Group method to serve as an additional venue for data collection, looking to explore important aspects observed during and after data analysis. It involved three stages: planning (defining the agenda of the sessions), conducting the group interaction, and analyzing the data. The previous analysis of the questionnaire and the bivariate data analysis guided the focus group sessions. The data was coded according to the conceptual framework of

documental genesis, reflective practitioner, and the use of technology as cognitive artifacts and facilitators of collaboration and sharing.

A theoretical framework grounded the search for evidence that documentation fosters a reflective attitude about practices. The framework also sought to establish a relationship between reflective practice and improvement of these practices, also suggesting that this improvement of practice most likely could end up in the improvement of learning as well. The digital aspect relates documentation to distributed cognition, assigning to digital media an important role in the constitution of such documentation work.

The goal of the focus group was to deepen the understanding of the teachers' view of the relationship between documentation work and reflective practice. This strategy concentrates on grasping conceptions and different views from the participants through their interactions, focusing on their views on digital documentation as a potential facilitator of critical reflective practice.

In order to accomplish this, we invited teachers (the ones who showed interest) through emails to participate in the sessions. The meetings were set for after their mid-year recess (July 2019) at a location selected for its easy access.

Unfortunately, the focus group did not happen as planned. The first group had 6 teachers confirmed (we did two rounds of confirmations - the second one was closer to the meeting day) but only three teachers showed up on the day. We used the space reserved, the room setting, the supporting professionals (to observe and to take notes) and run the sessions. We are well aware of the limited number of participants but the results were, nonetheless, interesting and, later on, they somewhat matched the ones from the interviews.

The second attempt failed as well. Out of the seven contacted and potential participants, only two reconfirmed their attendance in the days before the meeting. We canceled the session but one teacher did show up. Despite not being at her workplace, we decided to administer the semi-structured interview, beginning the cycle of the third instrument to gather data. At one point, we considered not doing interviews at all due to time constraints, however, the difficulty of executing rich and representative focus groups encouraged us to seek to use this third instrument.

Semi-structured interviews145

Depending on time and availability, some interviews were able to deepen the investigation and could be used to exemplify the object of study: in our case, the action of documenting one's own practice and its relationship to critical reflection. Our interviews were semi-structured (Manzini, 1991), as they were based on a script of predetermined questions but nonetheless allowed continuous conversation between interviewer and the subjects (as long as the conversation "was on" the themes of interest). Semi-structured interviews have some predefined questions to be addressed but enough freedom to change their order and to consider some other topic of interest during the interaction process. This model allows for a better differentiation among the participants; however, as it is more flexible, it demands thoughtful preparations, interviewer's concentration and ability to adapt (Manzini, 1991, 2003).

This last data collection revealed itself to be very rich and significative. We made an extra effort of dealing with time constraints; we had to contact, ask, convince, invite, and reach all the teachers who had offered to participate in groups and interviews when answering the survey (45 teachers, about 58% of the total). As for the interviews, we emailed each teacher with individual, personalized messages (more than once) and offered a variety of options concerning days and time for a visit at their schools. The idea was, one more time, to invite (and interview) professionals from all 11 different districts, looking for diversity in the data. Despite not interviewing teachers from all districts, we strongly believe that the data collected represents well the existing practices. By the end, we had 12 interviews scheduled, but a challenging strategy to cover very distant and different schools in such a limited time.

The interviews were recorded and lasted from 15 up to 100 minutes. In total, there were about 11 hours of recordings, all transcribed in their entirety using Atlas.ti software, in which they were categorized based on Ground Theory in light of our theoretical framework.

The intention was to use the time with teachers as an opportunity to see their documents too: content, organization, utilization, the circumstances in which the documents were constituted, and tools and digital instruments used along with

[145] Attached in appendix 13.

work. We also took into consideration the planning of the didactic scene, resources (textbook and digital resources), interaction with colleagues, rubrics and other methods to assess learning and progress. By doing so, we investigated teaching practice "from the outside" ("outsider researcher", Walsham, 2006). The document analysis searched for evidence to strengthen our conclusions and results.

Both the focus group and interviews were carried out after having the questionnaire results. The participants were selected based on the data collected with the first instrument. Both instruments were analyzed based on the same set of categories, as listed below:

- *focus group/interview sessions* (explanations of the rules and expectations)
- *personal narratives*
- *professional/pedagogical narratives*
- *transformation/modification* (content indicating concerns and commitment to transformative practices)
- *technology uses (*all uses; to plan, to look for and show content to students, to assess, to differentiate instruction, and to document)
- *planning pedagogical content* (concerns and actions)
- *considerations about students* (students' cognitive level, personal issues, students' motivation, and other peculiarities)
- *empathy/sensibility/perceptions* (students' reality – economic and social issues)
- *academic research* (use of content and class material in academic research – articles, books. Higher education, professional development)
- *assessment* (ways of assessing students – formative and summative assessment)
- *documentation (registration/archive)* (pragmatic use, organization)
- *documentation/portfolio* (myriad of materials: class presentations, students' work, assessments, web sites, communication, etc.)
- *teachers' background* (past experiences and professional development)
- *reflection* (indications of a reflective attitude)
- *collaboration/community of practice* (interaction with other professionals, connections and proactiveness in sharing and interacting)
- *related key concept* (content showing actions about documentation, reflection and use of digital instruments, in relation with each other)

5
DATA ANALYSIS

"It's an imperfect world but it's the only one we've got."
Tony Stark - Iron Man, 2008

The literature review and the theoretical literature used to support the analysis, interpretation, and comprehension of the data collected will then essentially feature: a) instrumental genesis (with extension to documental genesis), b) technological resources as cognitive instruments, and c) reflective practices, all of these understood based on the conceptual framework of Activity Theory.

We will present the data analysis in five moments: First, the demographics of the group; then, the teachers' perceptions about our topic of study: documentation, reflection, digital instruments; third we will look for patterns and tendencies when investigating the results of the bivariate analyses; and, lastly, we will present the results from the focus group interactions followed by the ones from the interviews.

It is paramount to point out that our subjects were screened prior to participating in the study. We pre-selected schools; once in schools and after presenting the investigation, we then encouraged the participation of the teachers who fulfilled our profile. The survey results might appear exaggerated insofar as very high percentages were found in some of the questions. Most of our multiple-choice questions were in the format of a Likert scale[146]. We considered as positive answers the ones under "mostly agree" and "strongly agree", and the corresponding opposites as negative answers[147].

One might punctuate that such screening results in biased findings. We dare sustain that we used intentional sampling. Only when concentrating on a population with specific behavior and attitudes could we verify tendencies and patterns. There was no sense in surveying randomly chosen teachers as most likely the results, interactions and discourses would lead us nowhere worth

[146]For a brief explanation about this instrument, see https://www.britannica.com/topic/Likert-Scale.
[147]The same pattern [was observed] for "almost always" and "always", and "almost never" and "never".

investigating in order to seek relations between documentation work, use of technology and reflective practices.

Sections 6.1 to 6.3 will concentrate on the survey results, which will be presented according to our main fields of interest: use of digital technology, reflective practice and documentation work.

In section 6.4, we will present relevant dialogues and interactions between our three participants, in light of what was found in the survey analysis. Lastly, in section 6.5, we will analyze the content in order to illustrate teacher's practices and perceptions concerning use of technology, documentation and reflection and to compare results, trying to verify patterns and suggest further studies.

Without much ado, we will present now our results.

5.1. Demographics and school structure

Our visits to 80 public middle schools all around the City of Rio de Janeiro and our contact with close to 200 middle school teachers gave us 78[148] valid responses, all filled in on the online version of the questionnaire.

It is important to understand the respondents' demographics, as in our analysis they will be related to the conclusions about attitudes, practices, and beliefs.

Taking as a starting point that in Brazil a student can graduate from university and become a teacher as young as 21 years old, we were able predict that the majority of our public would have some experience in teaching based on their answers about their years of teaching. In fact, we found that 87% of them were aged 31 or more, and more than 92% had been teaching for more than 11 years. The average was more than 14 years with a maximum of 32 years teaching middle school grades.

The area of teaching is pretty diversified. Mathematics, Geography, Sciences (Biology, Physics, and Chemistry), and History account for 77% of the

[148]Out of the 78 participants, 6 answered that they are not "teaching" regular classes at middle school level. However, their information is considered as if they are all middle-school certified and experienced teachers, working in special classrooms, such as multimedia, library, and reading rooms; all of which engage in continued work with middle school students and have a consistent practice of teaching and learning.

participants, with respective percentages of about 15%, 16%, 26%, and 20%. Physical Education and Arts only represent 2% and 4%, respectively. A possible explanation for this is the small number of classes for each of these two subjects. Unless the school is big and has many classes per grade, teachers have to attend different school buildings throughout the day, and for this reason it was less likely for us to meet one of them during our brief one-time visits.

About 85% of the teachers had completed higher level graduate studies, such as a master's degree, doctorate or at least a post-graduate certificate. Besides this, about 50% of the population attended a special course related to ICT topics; which were short-term courses (up to 50 hours) offered by the government. Fewer than one-fifth of the total population of 78 teachers pursued additional ICT courses that were not funded by public resources and tended to last more than 50 hours.

We were able to discover that about half of the courses dealt with general concepts of education and technology, and their names revolved around similar words like *education*, *technology*, *media*, and *learning*. For example, there was "education and technology"[149], "information technology in education"[150], and "digital citizenship"[151]. The other half was more specific, with names such as "gamification"[152], "new technologies for the teaching of Math"[153], and "programming with Arduino"[154].

About 85% (66 out of 78) of the teachers teach classes with more than 30 students[155]; based on data from INEP[156] (2018), these classes are larger than the ones found in private middle schools, and also in federal or state middle schools.

In addition, in table 2, about 47% (37 out of 78) teach a single grade, and about 1/3 of the teachers teach three or more grade levels. Based on this data, we can infer that the teachers in our sample have a complex and challenging work environment: large classes with a variety of different subject levels.

[149] "Tecnologia educacional".
[150] "Informática na educação".
[151] "Cidadania digital".
[152] "Gamificação".
[153] "Novas tecnologias no ensino da matemática".
[154] "Arduíno".
[155] Questionnaire question 13.
[156] Data from Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira - INEP. Available at:http://inep.gov.br/web/guest/indicadores-educacionais

Table 2. Distribution by the number of middle grades being taught

Different grade levels taught (large classes)	Number of teachers
One grade level	**37**
Two grade levels	7
Three grade levels	**13**
Four grade levels	12
Other	4
Missing information	5
Total	**78**

Based on the schools visited, the teachers were questioned about the existing technologies that were working and accessible. Data pointed to 67% of the schools with laptops available to be used by teachers. About 52% of the teachers said that their schools have projectors and TV/DVD, and only 45% recognized the existence of broadband. However, concerning the available technology, during the presentation of our study they commented[157] on their realities as follows:

> "Despite the substantial number of laptops, they need maintenance".
>
> "There are netbooks[158], but the internet is very slow and it rarely works".
>
> "The internet does not work well. The notebooks also do not work well".

If we consider that we visited the best achieving schools in each administrative region, based on their IDEB, quality of administration, and student learning, then we would expect that the other middle schools would have a worse situation concerning infrastructure likely to facilitate practices contemplating digital technology and their documentation work.

[157] All sentences were translated by the author. In Portuguese (respectively): "Apesar de ter um número substancial de laptop, estão precisando de manutenção.", "Notebook, internet baixíssima velocidade, raramente funciona.", "Tem internet mas não funciona bem. Os notebooks também não funcionam bem."

[158] Laptops.

5.2.
Simple data analysis about our topics of investigation[159]

The second stage of data analysis focused on their perceptions about our central topics of investigation: documentation, reflection, and technology. The questions addressed teachers' practices in general but focused on their documentation work and the content being documented and their reflective behavior and how it is perceived in their teaching. It also focused on their professional use of technology, not only on the planning of the didactic scenes, but also on displaying outcomes and students learning, as well as facilitating documentation, collaboration, and sharing.

Perceptions of documentation

As mentioned in previous sections, when selecting schools, we used a filter that directed us to "high" achieving, public middle schools (highest IDEBs), with a minimum required technological infrastructure (for example, with broadband and computers available to students and teachers). We understood that, by applying this filter, we would increase the chance of finding professionals more committed to their jobs (we were assuming that high IDEB schools have a participative, engaged, and dedicated faculty), which could be linked to a practice of documenting, reflecting on and recording processes. The selected schools would also be more prepared to incorporate practices that demand and in fact use digital technologies.

At the time we visited schools and talked to teachers, we explained the study and used the opportunity to pre-select the population which would participate in the survey, as we were looking specifically for teachers who acknowledged their voluntary practice of documentation.

About 62% of the teachers said that their daily use of technology involved documentation and registration of practices, and about 95% agreed that, when connected to the internet, technology supports teachers in documenting their practices. We tend to believe that this documentation was motivated more by organizational goals and time efficiency than by an attempt to integrate

[159]Our data is composed of 78 teachers. We will display approximate percentages as the goal is to have an idea of the magnitude of each group being analyzed. We will round up results with 5 or more in the decimal place. For example, 76.5% will appear as 77%, and 76.4% as 76%. Again, we will show results using percentages as whole numbers.

technologies, thereby reflecting authentic, pedagogical and innovative[160] methodologies and transformation in beliefs, norms and world view, as expressed in Sterling's pyramid, which deals with consciousness levels (2010).

The data revealed that a small group of teachers used technology to produce texts, create collaborative documents, blogs, and video or audio products (25%, 23%, 8%, and 27% respectively). We could expect that all of these activities would likely be digitally documented, as they would be already generated in a digital environment. In contrast to these low percentages, the internet is used to access information, either in a structured and specific way (76%), or in a random manner (73%). This information is easily connected to "instrumental" documentation. We are calling instrumental documentation that dealing basically with a reservoir of activities and previously-used materials. We cannot claim that reflection is not involved or that when activities are reused, they are not meaningful, authentic and relevant. However, we suspect that teachers access technology more as *users* and less as *producers*.

For example, consistently more than 50% of them use technology to plan classes through reuse and transformation of existing material, whereas about 15% use it to create activities with their students (using Moodle for example) or to stimulate collaborative learning (Google Docs, for example) (see table 3).

Table 3. Application of technology to plan lessons

Uses of technology	**% of teachers who use technology almost always or always (%)**
I adapt materials (digital or otherwise), for future classes	72%
I revisit notes (digitally or otherwise), for future classes	72%
I re-use materials (through the internet or otherwise), for future classes	55%
I plan activities in which my students work collaboratively, using technology (Google Doc files, etc.)	17%
I use a virtual learning environment - VLE (Moodle, Google classroom, etc.), to create activities with students	15%

[160]By innovative methodologies, we will consider the ones that seek formative assessment, group work, collaboration, variety of techniques to show learning achievement (writings, posters, animations, films, interviews, dialogues, etc.), active student participation, encouragement of students' autonomy, open-ended questions and so forth.

In addition, about 68% of the teachers informed that they document the content developed during practice, and 90% use their personal computers to do so. About 77% declared that they document students' work but using their personal computer in 61% of these cases.

However, when asked about the types of content stored, only text production represents 37%, with all others such as using spreadsheets to manipulate data, graphs, and tables, producing videos, creating sounds, and manipulating images, representing no more than 21% each.

Table 4 shows some actions after teachers' practice. As we can see, some of them are closely related to documentation; in fact, we can even say that they represent a documentation process already. This is the case of example A in which teachers already document their notes for future reference.

We will consider as level 2 the examples B, C, and D. The first two represent the willingness to save some kind of record of what happens with the intention of inspiring and directing future action. Based on the teachers' answers, there is no evidence that these registers are done digitally, but they could easily be or turn out to be so. The last example, D, does not refer to notes but to real content that was digitally produced, and therefore, already ready to be digitally documented and organized.

Example E also refers to digitally constructed products, but we will call it level 3 because they speak of assessment. We lack evidence to affirm that the evaluation is digitally done, in which case, it could easily be assumed to be digitally documented. However, as the products mentioned are digitally produced, we might expect that they are saved and constitute potential material for further reference as well.

Examples F, G, and H represent actions based on motivation and attitudes most likely related to the improvement of practices. They are aimed at a) communication with other professionals and the development of a community of practice, b) engagement with research that links classroom reality with theory, and c) the questioning of one's own paradigmatic framework and all that it entails, respectively. Levels 1 through 4 assume an increment in the complexity of the action after a teacher's practice.

Table 4. Actions after teachers' practices

Level	Example	"After my practice I…"	% of teachers (total of 78)
1	**A**	… have a digital file (on the computer) on which I save my notes and observations about my practice for future use.	55%
2	**B**	… make notes about achievements and areas (activities, procedures) that need to be improved or changed, for future examination.	45%
	C	… make notes of any nature in a non-systematic way.	45%
	D	… use technology in students' culminating learning process (products - videos, pictures, tables, graphs, texts, animations, diagrams, etc.).	36%
3	**E**	… evaluate students' technological work (videos, pictures, tables, graphs, texts, animations, diagrams, etc.).	36%
4	**F**	… talk and discuss with my peers, asking their opinions and suggestions.	51%
	G	… think about my experience as a potential topic to develop research.	47%
	H	… think about the positive and negative influences that my previous teachers have on my own daily decisions.	49%

Despite the lack of data to affirm that these actions are generating documentation work, we can at least suspect that this is the case, as 95% of the teachers recognize that, when the technology is connected to the internet, they document and register their general practices. For example, when detailing their answers, we found that 91% of them document successes and challenges for future reference, 90% document activities to be evaluated and used in the future, 87% document class planning to be modified according to diverse situations, and 90% save the content produced and used, to be shared and discussed with colleagues and other professionals.

These results match our belief that documentation can be related to professional development (which we will later investigate in relation to

reflection). When we determined that the actions shown in table 4 are approximate to a possible documentation work, and indeed represent teachers' habits, and we investigated what teachers say about their professional development, we found that 70% of them shared ideas and experiences with other professionals (level 4, example F), and 77% of the teachers investigated and analyzed past practices to inspire future actions (relating to levels 1 and 2, examples A and B, respectively). This is no surprise, if we assume that committed teachers seek improvement and act accordingly.

When documentation relates to reflection

The central idea of the study was to find a connection between teachers' documentation and reflection about their practices.

Teachers perceived themselves as reflective practitioners when they chose specific sentences to represent their thinking after a practice (see table 5).

Table 5. Sentences that represent teachers' after-practice thinking

"After my practice, the sentences that best represent me are:"	**% of teachers (total of 78)**
What can be done to improve student learning?	87%
Where can I find alternative materials and ideas to improve my practice?	77%
Was my planning adapted or modified to accommodate my students' socio-cultural reality?	73%
Are there alternatives to approaching this content?	71%
Does my practice encourage students' autonomy?	68%

Besides this, about 85% said that they recognize the relationship between documentation and reflection[161], when asked if digital documentation had any relationship with reflection about practices; and about 77% affirmed that they analyze past practices to develop their professional performance[162].

[161]Question 34.

[162]The question was: "For my professional development and the improvement of my practice do I analyze my own past practices?" 77% answered "always" or "almost always". Question 29.

However, only 55% of them affirmed that they have a digital file to organize their perceptions and general notes for further analysis, which matches the group of 54% of teachers who chose, *I will record successes and challenges so that I can revise and reuse them in the future,* as a sentence to represent their thinking and action after their practice.

We might want to deepen the investigation in the future to detail the reasons why the majority of teachers recognize not only that documentation favors reflection (85%), but also which attitudes give rise to reflective behavior (table 5), and yet only about half of them actually do document pedagogical actions.

It is curious though that, when identifying reflective attitudes[163], 95% or more agreed that the following sentences are *all* related to teachers' reflective attitudes:

a) comparing class planning with what was really taught, to later review and readapt for future practices,
b) verifying which class objectives were achieved and, if necessary, redesign future practices,
c) thinking about and modeling practices so that they encourage students' autonomy and the development of critical behavior,
d) planning practice according to professional environment and teachers' beliefs about the teaching-learning process.

All of these actions had *at most* one teacher who partially disagreed with the assumption; all of the others agreed with these statements at some level.

On the other hand, the assumptions that refer to documentation or registration had the lowest percentages, although they still had a high percentage of teachers agreeing that they too represent reflective attitudes (around 90%),. We found teachers who strongly disagreed or totally disagreed that these actions represent reflective behavior as shown in table 6 below:

[163]The question was: "We recognize a reflective attitude when the teacher…"

Table 6. Relating documentation to a reflective attitude[164]

	Totally disagree (number of teachers / percentage of total)	Partially disagree (number of teachers / percentage of total)
"we identify a reflective attitude when teachers register challenges and successes after their practice for future investigation"	2 (3%)	1 (1%)
"we identify a reflective attitude when teachers document/save their practices, their class planning, and students' work for future use"	2(3%)	1 (1%)
"we identify a reflective attitude when teachers document/save their practices, their class planning and students' work for future evaluation"	1(1%)	0 (0.0%)

This 90% matches the 85% (already mentioned) who believe documentation relates to reflection. What drew our attention was these 1 to 3 teachers who specifically discredited documentation practice[165]. We could even risk saying that they are rejecting this practice. All the other attitudes (the survey had a list of 8 in total - question 33), besides having a higher percentage, did not feature anyone in strong disagreement with the assumptions.

Another intriguing observation was that the second-lowest percentage of agreement[166] was related to the sharing of practices and experiences (90%), which is connected to the development of communities of practice.

The highest percentages were the assumptions that dealt with individual, intimate behaviors, which featured a "general meaning" without a specific connected action behind them; for example, teachers referred to actions such as "think", "verify", "compare" as highly related to reflection, yet these attitudes can and also do occur through documentation. In fact, our point here is that

[164]Question 33.

[165]The question was: "We recognize a reflective attitude when the teacher…" (there was a list of options (actions) that could be selected).

[166]The question was: "We recognize a reflective attitude when the teacher…" (there was a list of options (actions) that could be selected).

documentation specifically causes these actions, the ones recognized as reflective, to happen.

As defended previously, when establishing the theoretical framework, there were many definitions of reflection as well as peculiarities for its content and resulting consequences. We sought metacognition on reflection, that facilitated when teachers engage in documenting their practices. Moreover, we investigated whether digital instruments facilitate and welcome such documentation. Practices, in general, were changed due to the more intense interaction of ICTs in all social and pedagogical interaction processes. Such modification also refers, but not only, to a) digital products, which are more frequently used to demonstrate learning achievement and easier to be documented, and b) virtual environments and software that is structured to receive such documentation.

Technology and teacher practice

If we want to investigate the use of technology not only to express the development and culmination of student learning but also to model teaching practices; and if we also want to observe teachers' attitudes and beliefs about digital documentation, then we might need to analyze first how technology participates in and facilitates the pedagogical process.

We can observe two conflicting scenarios; one that encourages ICT in school practices and another that challenges it.

We have almost 85% of teachers with higher degrees such as a master's and doctorate, but fewer than 50% with a teacher training course on technology, either a special course such as a programming language, or a more general one about technology and education. The majority of teachers teach large and many different classes, which could be an indication of physical exhaustion and lack of time to engage in innovation and in-service training. In addition, only 22% said that they have computers inside classrooms, and remarkably fewer than 4% said that their schools have working tablets available for teachers and students to use. This situation matches the results from *TIC Educação*[167] research, I which we find 48%

[167]TIC Educação is a nationwide study aligned with the theoretical framework proposed by the World Bank and also with the study, Sites 2006 (Second Information Technology in Education Study), by the International Association for the Evaluation of Educational Achievement (IEA). It has existed since 2010, and includes interviews with school administration, teachers and students to try to map the access, use, and appropriation of ICT at public and private primary schools. The

of the teachers with some sort of training in technology and education. The majority of the teachers have a perception that a) outdated computers (56%), b) lack of a reasonable number of computers per student in schools (65%), and c) the overall insufficient number of computers in their school (59%) are the main causes of the barriers for ICT use in schools (CGI - TIC Educação, 2017).

In order to detail the path that could encourage and result in documentation, it might be clearer if we describe our data about technology in two groups: One related to the use of ICT with students and inside the classroom, during a didactic scene, and the other related to teachers' use of technology before and after classroom practice.

Use of technology in classrooms

The majority of the teachers recognized that available technology changes important pedagogical practices such as learning opportunities (96%), teaching methods (92%), and assessment formats (89%)[168]. However, we found some contradiction when 77% of the teachers said that networked technology encourages them to use alternative and differentiated methods to assess students learning, whereas only 35% affirmed that they use technology in their practice to assess students' performance. This last datum is reaffirmed when 40% said that they use technology to assess students through pictures and images and another 37% verify learning through spreadsheets with calculations.

In addition, only 37% of the teachers confirmed that they use ICT in class to engage in different and innovative activities, the most common one being text production (25%), which does not necessarily imply collaboration between students, or the development of higher order skills for example. Photos and images, as well as digitally developed texts, are examples of new products, introduced with ICT, that can only be documented through a digital resource.

Further studies could investigate why teachers believe in the changes in teaching and learning processes introduced by the use of ICT, but in practice, far

section that investigates teachers' beliefs and attitudes considers their professional profile; use, abilities, and specific training related to the ICT; pedagogical activities proposed by the teachers; perception of the challenges to incorporating ICT into the teaching and learning process.

[168]The question was: "I use digital media in my pedagogical practice to…" (there was a list of options (actions) that could be selected).

fewer are really incorporating them into their practices. There are always some suspicious issues, such as lack of infrastructure (computer and internet), lack of knowledge on the part of the teachers (continuing education), unsupportive school administration, discrepancy between teachers' plans and real practice, an excessive number of external tests, and content and learning outcomes being externally determined and evaluated.

Use of technology pre- and post-practice

The most common practice involving technologies adopted in preparation for classes is to search for content on the internet (92%); in addition, teachers access specific portals (76%) and do random web searches (73%). Their planning involves repurposing material (72%) and revisiting their own notes (72%).

A group of teachers (41% of the total) investigate other professionals' practices; when distinguishing this information later in the questionnaire, some teachers affirmed that they meet with other professionals (45% of the total), sign and read professional publications (44% of the total), and only a few observe other teachers' practices (27% of the total). These results raise two points to be discussed. First, if only 41% of the teachers investigate other professional practices, how could 45% of the teachers meet with other professionals, if this option somewhat works as a subitem of the previous one? The same applies with the reading of specific publications. Second, the frequency of "observing other teacher classes" usually carries a bias related to willingness and the real possibility of it happening, as we are not sure about the availability of time to do so as well as the permission and encouragement by administration for the teachers to develop such a habit.

To improve their practices, teachers exchange experiences (68%) and review past practices (77%); but not so many participate in virtual study groups (15%) or collaborate on professional pedagogical channels (23%). Time always seems to be an issue for public school teachers, but we did not have additional data to make further inferences as to why these two percentages were low.

After their practice, teachers said that they save the material used in their classes in two moments on the survey: one had 62% of agreement and the other 61% (this is the most common practice after the use of technology during their teaching). The following two approaches after their practice are talking and

discussing results and class sessions with their peers (51%) and communicating results with the school administration (55%). This last result contrasts with the 16% who communicate with parents and students' guardians, making us suspect that communication with administration might be mandatory.

All of these results could show us patterns and important additional information when analyzed in a more detailed way. We will now proceed to show the results obtained from a bivariate analysis, and after that the additional and corroborating findings gathered from the focus group and from the interviews in sections 6.4 and 6.5 respectively.

5.3. Finding patterns and relevant relations

A second analysis was carried out with the use of bivariate statistics. We decided to cross-reference some variables, thereby trying to find patterns and relationships that could inform us about motivations and tendencies in the use of ICT, in documentation practices, and also in reflective attitude. We calculated 61 correlations (see table 8) resulting in 293 double-entry tables.

As shown in the table below, we related teacher's profile variables, such as age, time working as a teacher, content areas of teaching, teacher's degree, participation in ICT courses, current number of classes teaching, and average number of students enrolled per class, to other variables such as use of technology in their practices and their perception of what a reflective professional is, among others.

Table 7. Selected bivariate analysis

X	**age**	**time working as a teacher**	**content area of teaching**	**highest degree**	**specific courses**	**number of classes**	**number of students per class**
daily use of technology	✓	✓	✓	✓	✓	✓	✓
use of media to evaluate	✓	✓	✓		✓		

students							
to plan my classes I...	✓	✓	✓		✓	✓	
I develop practices that stimulate...	✓	✓			✓	✓	✓
after my practice I...	✓	✓				✓	✓
after my practice I save my documents	✓	✓	✓	✓	✓	✓	
after my practice I record students' work	✓	✓	✓		✓	✓	
sentences that represent me	✓	✓	✓	✓		✓	✓
to improve my practice I...	✓	✓	✓	✓	✓	✓	
agreement with some affirmations	✓	✓		✓			
agreement with some sentences	✓	✓		✓	✓		
perception about reflective attitude		✓		✓	✓		
is digital documentation related to reflection?	✓	✓		✓			

5.3.1
Use of digital media

When analyzing teachers' use of digital media (see table 8), we decided to consider them in four subgroups; one dealing with pre-practice, one focusing on practice *per se*, one that we named "giving back"; and the last one named "professional development" due to dealing with teachers' attitudes after their practice, which are easily related to professionalism and also committed to the improvement of practice.

Table 8. Summary of teachers' uses of digital media

	In my daily practice, I use technology to...		**Rarely or Never**	**Sometimes**	**Usually or Always**
pre-practice	*investigate different practices*		17	42	41
	search content related to my practice		1	6	**92**
	plan my classes		6	22	**72**
practice	*perform diverse activities with students*		12	41	48
"giving back"	*evaluate students' work*		**40**	26	35
	communicate learning process results		**39**	21	41
"professional development"	*document and record my practices*		15	23	62

Pre-Practice

The data about pre-practice showed that the majority of teachers (92%) used internet to search for content and alternative materials for their practice, followed by the second largest group of 72% of the teachers who used digital resources to plan their classes. We assumed that they not only identify the web as a source of valid material but also that they have the skills to do so. We came across this similar result after analyzing the content of the interviews (discussed in section

6.5). When broken down by specific groups (correlations), we identified some interesting patterns.

The habit of searching the web for both other professionals' practices and content for own practice is not correlated to the time that one has been teaching, to the subject taught, to the size of the classes, and to whether or not a teacher has taken a specific course involving technology. However, all social sciences and language teachers said that they use the internet to find content to plan their classes. The only relationship found from these three analyses[169] is that teachers with a higher degree are more likely to find content and do their planning with the use of technology; 100% of the teachers with a PhD search for extra and alternative content on the internet and 71% use digital resources to plan their classes, compared to 83% and 33% for teachers with only with a bachelor's degree, respectively.

When planning classes, teachers reuse (55%) and repurposed materials (72%), whether digital or not; they revisit their notes (72%), save sites and portals useful for planning (63%), modify internet content (50%), and use virtual environments such as Moodle, and Google Classroom to create activities (15%); they also think about activities that students can work on collaboratively, for example, through Google Drive (G-docs) (17%). In addition, based on what teachers answered, we can say that pretty much all teachers reuse and repurpose material from the internet at some point according to varying degrees of frequency.

In addition to these low percentages, only about 41% of teachers plan activities in which students can work collaboratively, and almost 60% of the teachers have never used virtual learning environments such as Moodle or Google Classroom[170], what could be due to a lack of motivation, interest, knowledge, infrastructure, or maybe time to learn new practices. About 70% of the teachers who *never* used such environments had not taken any specific technological course. This finding supports the data that 90% of the teachers who did not do such courses had never used virtual learning platforms.

[169]Investigate different practices by other professionals and search for additional and alternative content for own practice.
[170]The question was: "For my planning I…"

All the data reinforces that "giving back" activities are rarer. Teachers are motivated to prepare and active in preparing materials for their classes (repurpose, reuse, revise and web search), but it seems that the materials are directed at a more traditional classroom, not involving practices and abilities such as cooperation, collaboration, creativity and use of digital skills. Mathematics teachers stand out though. Despite representing only 12 out of the 78 teachers, 3 of them answered that they *always* use collaborative activities such as ones made possible by Google Apps in their practices.

We found some expected tendencies such as a) less time being a teacher with less reuse of material, probably because they are still trying out and building their own repertoire of resources, b) more frequent use of digital resources in planning by teachers who have done a specific ICT course, and c) more experienced and older teachers never having used virtual environments, due to lack of knowledge or lack of motivation, perhaps linked to the concept of *self-efficacy* by Bandura (1977a).

It was curious that 5 teachers said that they had never modified internet content to be used in their planning. When breaking down this information, we found no correlation with age, classroom size, number of students per class, extra technological knowledge through continued learning, or area of interest.

Still regarding teacher planning, the majority of the teachers rarely or never developed pedagogical practices involving technology (data manipulation, graphs and table construction, text elaboration, video production, image manipulation, or sound creation). This data has no further correlations with variables such as age, time of teaching, area of interest or class size. However, there is a clear indication that continued learning in technology does make a difference. Even though showing low absolute percentages, there is consistency in higher percentages for planning activities that use and/or rely on digital resources for the group that engaged in extra specific courses as shown below (see table 9).

Table 9. Use of technology to plan pedagogical practices (%)

To plan my practice, I develop pedagogical activities such as:	**YES**	**NO**
manipulation of data	24	20
construction of graphs and tables	29	13

elaboration of texts	47	28
production of videos	34	8
manipulation of image	21	10
mixing and creation of sound	24	**0**

Continued learning - ICT courses

Clearly, we might suspect that some of this data is due to the lack of structure for using virtual environments with students (no computers, no internet, no time, no support from administration), even more considering the pupils of middle public schools in Rio de Janeiro. Still there is evidence that digital resources are being used mostly to repurpose and revisit notes about old practices, and not to create original content or to engage students actively in their learning process.

Practice

Based on our sample, the size and the number of students per class, age and teaching time do not correlate with the habit of documenting students' work or using digital media to perform activities with students.

Table 10a. Clipping of teachers' uses of digital media - *Practice*

	In my daily practice, I use technology to...	**Rarely or Never**	**Sometimes**	**Usually or Always**
practice	*perform diverse activities with students*	12	41	48

We found that the great majority of teachers affirm that they save and record students' work and also that all teachers with a PhD degree said that they perform activities with digital resources with their students. For both data, there was a positive correlation with attendance at ICT in-service education courses. About 75% of the teachers who indicate always performing activities with digital media and 90% of them usually documenting students' work attended those courses. One might wonder whether continuing training not only helps to model alternative and creative activities that contemplate digital media but also fosters the development of abilities to plan, create and perform.

"Giving Back"

On the other hand, technologies are much less used when the action involves "giving back", such as communicating results and evaluating students work. The use of ICT to communicate with others displayed the lowest percentage (39%) in table 8 (partially reproduced below - table 10b), indicating that technologies are not being used to facilitate communication, making it faster or more reliable, or to connect guardians and teachers, for example.

Table 10b. Clipping of teachers' uses of digital media - *Giving Back*

	In my daily practice, I use technology to...	**Rarely or Never**	**Sometimes**	**Usually or Always**
"giving back"	*evaluate students' work*	**40**	26	35
	communicate learning process results	**39**	21	41

Also, close to 40% of the teachers have *almost never* or have *never* used digital technology to assess students' work through the design of comprehensive rubrics, or the use of alternative methods supported by technology. The correlations did not return a positive relationship with the other variables, only when cross-referencing the data with specific ICT training; these teachers tend to use more digital channels to communicate achievement and evaluate students' work. Among our population of 78 teachers, there are 12 teachers who have *never* used digital media to evaluate students' work. Again, we might question what public education directives say about the integration of technology in pedagogical practices. If technologies are to be present in public schools and teachers able to perform activities with such a resource, it should be expected that the assessment of students' work be done with the use of such resources. We also find it curious that 15 teachers do not use digital media to communicate results of learning processes.

We investigated teachers' assessment practice focused on different students' performances. It is interesting to note that most of the teachers had *never* or *almost never* evaluated their students' outcomes using digital media in the format of interviews (64%), dramatizations (75%), spreadsheets (49%), production of text (53%), pictures and images (36%), and videos (52%). At another moment,

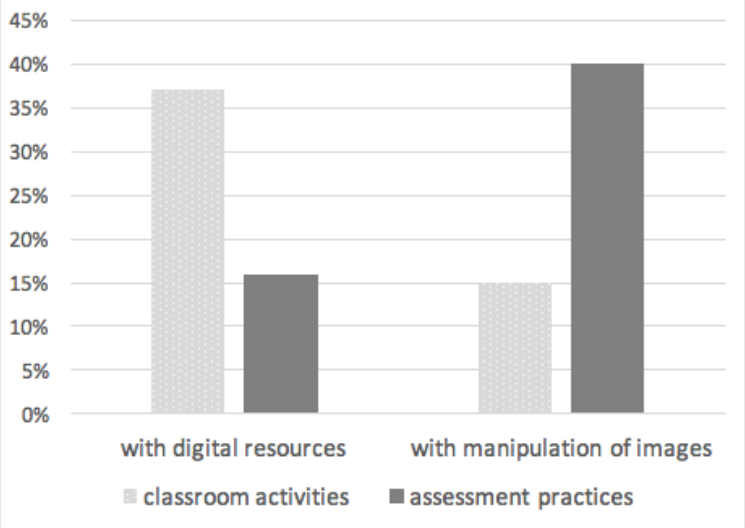
one-third of the teachers reaffirmed that they had *never* or *almost never* used technology to encourage student production as a culmination of their learning process, and only about 35% said that they assess technological production by students.

The only additional data that is aligned with expectations based on common sense was a) spreadsheets are less used by humanities teachers, such as geography and history, b) dramatizations are less used by mathematics teachers, and c) more experienced teachers tend to use less alternative/innovative/digital assessment instruments. Most of these findings are consistent with the teacher planning information in the "pre-practice" section. About 50% of teachers *never* or *almost never* develop practices that involve digital media in their planning, so the lack of those instruments when assessing students' performance seems to make sense.

We noticed some discrepancies, however. About 37% of the teachers plan text writing activities with digital resources, but only about 16% use such an instrument to assess student learning. In addition, about 15% of the teachers plan and encourage activities that manipulate images with digital resources, but more than 40% use this ability to assess student learning. This discrepancy seems to indicate a disconnection between content being explored in class and that which students are being assessed on (see graph 1).

All of this evidence works against the use of digital documentation in public middle schools, as they end up not constituting digitally authentic content to be documented.

Graph 1. Classroom activities vs. Assessment practices



The lack of "giving back" practices could be a result of many contextual elements such as precarious structure without enough available and working computers to engage in activities with students, lack of time, since many teachers work at different schools and at more than one school per day, insufficient continuing training to inform and develop skills to apply in the creation, application, and assessment of innovative activities, and also lack of habit and school culture as to communicating the outcomes of students' learning processes.

Professional Development

Our last investigation under this correlation is about the use of digital media to document and record practices.

As illustrated in table 10c, one repeating piece evidence is that, again, teachers with a specific course in technology tend to document their practices more and the content developed by them. In addition, almost all mathematics and language teachers somehow document their practices; more than 83% of these teachers document the content they create.

Table 10c. Clipping of teachers' uses of digital media
Professional Development

	In my daily practice, I use technology to...	**Rarely or Never**	**Sometimes**	**Usually or Always**
"professional development"	*document and record my practices*	15	23	62

Moreover, about 45% of the teachers said that they make some notes after their practice in a non-systematic way, and 5 of those teachers said they *never* take notes after their classes. This last piece of information was surprising since we pre-selected teachers who voluntarily document their practices somehow.

Another intriguing result was that one-third of the teachers *never* digitally save their files such as projects, texts, list of activities, and exercises. The only reason for one not to save a created file would be if that work was not done digitally. Even without computer and internet in schools, we might assume that teachers living in a big, urban city such as Rio de Janeiro would have access to

such technology in their homes. Based on data from *TIC Educação*[171] (CETIC, 2017), 91% of teachers have computer(s) at home (whether portable or not), and 99% of them have internet at home.

A deeper investigation of this data shows no relationship between the results about documenting practices and taking notes for future investigation, and variables such as age, number of classes per teacher or number of students per class. However, there seems to be a tendency that more experienced teachers are more used to taking notes after their teaching, as more than 85% of them said that they do so with some frequency.

When investigating the use of digital files to save their class observations for future analysis, we found higher percentages for the group with less experienced and younger teachers. In addition, there seems to be a negative correlation between size of classes and habit of saving observations in digital files (75% of the teachers save notes in a digital file and the average for saving notes in larger classes is around 50%). However, only 4 of the respondent teachers teach smaller classes with up to 20 students in them.

5.3.2. Considering digital technology

When considering the effects of available ICT in education (see table 11), teachers consistently affirmed that digital resources have modified old practices and have introduced new ones (92%). The highest percentage relates to new learning opportunities (96%). However, we saw in the previous analysis that few teachers contemplate differentiated forms of assessment and they also do not adopt collaborative practices using technology. Maybe they realize the impact of the ICT on education but unfortunately their reality does not afford the introduction and use of digital technologies as they would wish. Besides, there is always "teaching for the test", which tries to account for the pressure of external tests and exams designed by the government based on their suggested curriculum; in section 6.5, we will refer to more than one interview in which teachers mentioned lack of autonomy and time.

[171] See note 168 about *TIC Educação* on section 6.2, and subsection "Technology and teacher practice".

Table 11. Consequences of the availability of digital resources

The availability of digital resources modifies...	**Totally or partially disagree**	**Neither agree or disagree**	**Totally or partially agree**
learning opportunities	3	1	**96**
documentation methods	1	4	95
pedagogical methods	4	4	92
assessment practices	9	3	88
reflection habits and intensity	9	9	82

There is consistency in the perception of the impact of ICT on teaching practices. We observed that all the respondent teachers with a PhD degree never disagreed on that impact. Also, even with a much slighter difference than in the previous analysis, the teachers who attended ICT courses agreed more than the other groups (based on degree) with this statement.

We have three areas for possible further investigations. The first one is that, if practices are believed to change because of the impact of ICT in education, then assessment methods should follow that movement; if they do not, one might consider looking for impediments for that to happen.

Second, four teachers said that they *strongly disagree* about the impact and the changes that ICT has in reflection practices. Maybe we should investigate if that group does some sort of reflection and documentation at all. ICT in education introduces new ways of teaching and learning, as well as introducing differentiated forms of learning outcomes. If there is reflection, and if processes and relations are faster and more dynamic and connected due to the internet, then we might expect at least some consideration of the change in the frequency and intensity of reflection as well.

And third, if 9% of the teachers disagree that ICT changes reflection practices, a documentation process could help link these two loose ends. ICT allows for the outcome of new products, new interactions, new projects, and new communication between parts; through documentation work, teachers are able to

develop and enhance a reflection habit grounded in interaction and engagement with new instruments and resources. This change in attitude afforded by the connected technology is analyzed next.

5.3.3. Adapting practice to existing digital connected technology

There is a perception that connected technology changes practice. The teachers mentioned some areas that would most likely benefit from such technology, as demonstrated in table 12 below.

We can observe that the use of ICT to communicate with students' guardians was the only one for which fewer than half of the teachers agreed (46%). Actually, 18 teachers (23%) said that they *never* use technology and digital media to communicate with parents and guardians. We have some considerations here: Do they communicate but do so not through ICT? The existence of ICT does not in any way change their habits concerning communication methods and the channels used? Are these guardians able to receive and understand communication through digital technologies? Are the parents and guardians committed to and interested in their children's learning process? Does the school culture encourage such communication? If we think about emails as a channel of communication, do guardians have easy access to computers connected to the web to follow up on such communication? All these questions would need additional investigation in order to be addressed, but this is not our main focus at the moment.

Table 12. Pedagogical practices and connected technology (%)

Connected technology...	**Totally or partially disagree**	**Neither agree or disagree**	**Totally or partially agree**
invites me and facilitates the re-adaptation of pedagogical materials according to my students' realities	3	1	**96**
encourages me to register and document my practice	4	1	**95**
facilitates my collaboration with other professionals	6	6	87

allows me to observe learning processes and not only its products	9	13	78
makes me use it to communicate with students	9	14	77
makes me consider alternative methods to assess students learning	10	13	77
makes me use it to communicate with students' guardians	**36**	18	**46**

Contrasting data is found on the use of such technology to communicate with students. About 77% of the teachers agreed that technology is used with this purpose, despite only 37% of them using it to do so about the learning process, such as students' performance and accomplishments. We suspect that the majority of teachers are using it to assign work and as a channel to ask and answer questions (WhatsApp and Messenger from Facebook for example).

Furthermore, 4 teachers said that ICT does not make them collaborate with other professionals, indicating that they might not be part of any virtual community of professionals or, at least, even if they do belong to such communities, they do not perceive themselves as collaborating with discussions in that environment.

Three teachers *completely disagree* that ICT facilitates and allows differentiated forms of assessment, and 4 teachers *completely disagree* that technology allows for different ways of observing the learning process and not only the results. This made us wonder whether these teachers contemplate digital technology at all in their practices; even more, whether they realize that society, general social relations, education, school contents, and students have all changed with existing technology. Technology introduces new methods, motivates students differently, and allows for new forms of expression. Despite the structural difficulties that public schools have, there are certainly methods that contemplate technology in the evaluation processes of learning, which do not necessarily depend on "one computer per student" or even "an available and fast connection". We can think of interviews, short movies, use of pictures and web search as some examples.

96% of the teachers answer that they agree about the convenience that technology offers in "remixing" materials when planning their practices. This

result reaffirms that found in table 12 above, under which 92% said that they use digital media to search for content to plan their classes. In addition, about 95% of the teachers recognize that digital technology facilitates the documentation process. If the majority of the teachers also consider technology to apply alternative pedagogical methods and to observe and assess students' learning process (also from table 12), then the outcomes of these two processes could constitute material to be digitally documented.

When correlating the change in practice due to the use of digital technology, we did not find specific patterns according to age. There is a dispersion in the age range of teachers who completely disagree with these changes; sometimes they are younger ones, sometimes the older ones. The only suggestive result is that teachers with a PhD, despite representing only 9% of the total, are more willing to integrate new technologies into their professional practice; *all* of them agree that they readapt material based on their students' peculiarities, and also that they document and register their practices.

5.3.4. Self-reflection

The selection process of our population and the whole investigation of the integration of media during the pedagogical practice presumes a reflective attitude by teachers. We selected some sentences to be identified by teachers as ones that could represent their thinking after a pedagogical experience. We have listed them below (see table 13) in order to facilitate our considerations.

The most considered sentences deal specifically with their commitment to the teaching and learning process (sentences 1 and 2). We might affirm that the teachers concerned about the immediate improvement of learning, but there is no matching result for considerations about the premises used to define the curriculum enacted, their connection with other professionals, and the pedagogical method used.

However, about 75% of them are aware and take into consideration their students' reality (73%), and an unexpected (high) 70% are concerned with the development of their students' autonomy. This indicates willingness to consider and act upon concepts of equity, justice, and a responsible practice. When considering technology in those two processes, the use of digital collaborative

platforms such as Google Drive documents and spreadsheets would certainly be an effective way to foster differentiation, engagement, and active learning.

Table 13. Sentences that represent teachers thinking after practice

	After my practice my thinking is:	**% of teachers**
1	*What can I do to improve my students' understanding?*	**87**
2	*Where can I find ideas and alternative materials to enhance my practice?*	**77**
3	*Was my practice thought about and modified to meet my students socio-cultural needs?*	73
4	*Do alternative ways to approach this topic exist?*	71
5	*Does my practice encourage student to have autonomy?*	68
6	*Did this practice happen according to what was planned?*	60
7	*Did this practice fulfill my expectations and pedagogical objectives?*	55
8	*I will register challenges and successes to revisit and maybe reuse them in the future.*	54
9	*Time to think about the next topic to be taught...*	44
10	*How does this practice relate to my values and beliefs as a teacher?*	**35**
11	*How are other professionals working and thinking about this content?*	**30**

We can also say that the latter two indicate a disconnection from communities of practice and engagement with teachers' collaboration forums (30%), and no immersion into what we referred to above as a "double loop" or "level II" reflection, as there are no considerations about epistemological beliefs and about the self-conception of what it means to be a teacher.

The result for sentence 8 does not match the related ones in tables 8 and 12. About 62% of them said that they use digital media to record and document practices and about 95% of the teachers recognized that connected technology encourages documentation practices, respectively. This might indicate that, despite their perception that some sort of documentation is important and is

facilitated through the use of digital media, this is not yet a habit, as only about half of them think about registering their performance.

We cross-referenced these results with six variables: age, number of students per class, degree, subject, years of teaching, and number of classes being taught. This produced no strong correlations, just some indication that language teachers and ones with higher degrees appear to think more about their practice in general, which is irrelevant for our present investigation.

Based on the table above, we can also infer that most of our population said that they reflect after their practice and are worried about the means and the ends of their performance.

5.3.5. Awareness, commitment and professionalism

Teachers' awareness of their role in the learning and teaching process was investigated through some suggested actions. The most common one was the analysis of their own practice to inspire and model future practice; about 77% of the teachers appear to recognize that they almost always do so. However, corroborating previous results, only 15% said that they participate in virtual groups to discuss content and procedure; we might then risk to say that this points to lone reflective practice.

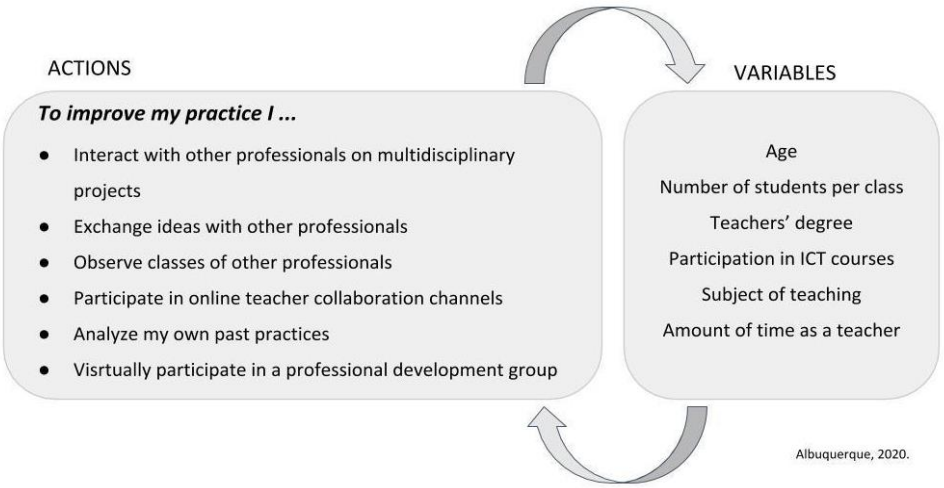
Somewhat disconnected results were found when asked about peer relations. In one question, 51% said that they *almost always* or *always* discuss with colleagues after their practice and in another question, about 68% agreed that they exchange ideas with colleagues to improve their practice. Moreover, more than half of the teachers consider peer criticism to be important to enlighten their own considerations. In addition, 50% of the teachers interact with other professionals in multidisciplinary projects as a way to improve their practices.

However, a minimal 23% of respondents said that they observe other teachers' practice or that they participate in online communities. There are great advantages and learning opportunities to be had on both sides, but this low percentage could certainly be, at least partially, explained by teachers' lack of time. Observing other teacher's classes demands considerable spare time and also free/planning periods during a teacher's schedule, which is rarely the case. This peer observation is of great value and was discussed long ago by Shulman (1986),

when he mentioned that teachers are lonely actors, without an audience of equals who would be able to perceive generalities to be continued or flaws to be reviewed. Unfortunately, this practice is not a habit in public schools in the city of Rio de Janeiro, and we might possibly even say, in most Brazilian public schools. This situation would constitute an argument and a motivation, together with other arguments as well, for defending the practice and the use of teacher documentation to make this knowledge more visible.

We correlated teachers' attitudes (actions) towards their professional development with the variables described in figure 20 below and found some tendencies.

Figure 20. Correlations between teachers' attitudes and specific groupings



Once again, there is consistency in the higher percentages for the group with ICT courses. They scored higher in all six attitudes on improving professional performance. Such differences are lower when the attitudes do not involve technical knowledge; for example, analyzing one's own practices and observing other teacher's class have closer percentages; 70% and 84%, and 20% and 26% respectively for the groups *with* and *without* specific courses. On the other hand, collaborating with other professionals through online channels and virtually engaging in a discussion group have percentages of 13% and 34%, and 8% and 24% respectively for the groups with and without ICT training as well.

Mathematics teachers tend to display a higher percentage for conscious action after their practice. They exchange more ideas with other professionals,

participate more in collaborative virtual channels, and also take part in discussion communities about education.

Half of the teachers affirm that they interact with other professionals to plan and execute multi-disciplinary projects. Two-thirds of this population have taken specific courses. Fifteen teachers said that they *always* engage in such projects but three of them said that they *never* do so; two of these teachers are from social sciences and language arts fields, which adds surprise to the data, as those areas usually engage in larger and connected projects especially at the end of bigger units of study.

Lastly, another "new" result was the participation of teachers with postgraduate certificates in the groups that *almost always* or *always* engage in the practices listed in figure 20. This group exchanged more ideas with other professionals, they participated in communities of practice and virtually participated in discussion groups about education. Maybe because this is post-graduate certificate courses are shorter than masters and doctoral programs, and these teachers are more focused on instruments, methods and ideas for their daily practice. We suspect that the teachers who enroll in specialization courses are usually active in classrooms and, because of that, also active in planning and finding solutions for their complex daily situations. On the other hand, it is not difficult to find master's and doctoral students that are not actively teaching while working for higher degrees, which might be one reason for more timid participation in these communities of practice.

5.3.6. Identifying reflective practice

In one way or another, our population agrees on what reflective behavior entails. More than 87% consistently agree that the following behaviors (see table 14) characterize a reflective attitude. Surprisingly, the highest score is related to the perception of a reflective practice when a teacher thinks and adapts his/her own practice to encourage students' autonomy and the development of critical thinking (97%), which certainly indicates professional commitment and social responsibility. Also, no teacher disagreed at any level with this statement.

Table 14. Perception of reflective practices

	We identify a reflective attitude when a teacher...	**% of teachers**
1	*... thinks and adapts his/her practice in order to encourage student autonomy and the development of critical thinking*	**97**
2	*... verifies if his/her teaching objectives were achieved and, if necessary, redesigns future practices*	96
3	*... plans practice according to his/her professional environment and his/her convictions about the teaching and learning process*	95
4	*... compares planning with what really happened during practice, and reassess and readapts the planning for future practice*	95
5	*... records challenges to and successes of the practice for future analysis*	91
6	*... documents and saves activities, lesson plans, students work for future analysis*	90
7	*... records the content used and the knowledge produced during a practice to share and exchange ideas with his/her peers*	90
8	*... documents and saves activities, lesson plans, students' work to reuse in the future*	87

Teachers with ICT training tend to agree more with these statements, but the difference between both groups is not relevant.

One teacher *completely disagreed* that when a teacher documents and/or records his/her practice, the activities used, and the processes developed for future analysis, he/she is involved in personal reflection. Besides this, 7 other teachers affirmed that they *do not agree* or *disagree*, indicating that they do not necessarily find a correlation between those two practices - documenting and reflecting.

Two teachers *completely disagreed* that digital resources change documentation methods; this would make sense if these teachers were not using technology to plan their classes; if they do so, then digital resources would be used to document materials and activities already digitally created.

95% of the population believes that a reflective teacher considers the school peculiarities[172], students' realities and his/her convictions about the teaching and learning process before planning his/her classes. This suggests a high level of

[172]Geographic location, social-cultural characteristics (students, teachers, neighborhood), number of students per class, number of classes and grades to be taught, school's political-pedagogical Project (PPP), among others.

consciousness, ethical commitment and responsibility: professionals who model their practices according to the specificities of each reality.

No one disagreed with sentences 1, 2, 3, 4, and 7. Yet, there remains a doubt about whether or not these teachers actually do engage in such practices. A possible bias in the question can lead teachers' perceptions and make them understand that a particular answer is the right one. In fact, the question about behaviors and attitudes appeals to a reflective professional because it deals with actions broadly accepted by common sense, such as thinking about the practice and readapting for future use and considering students' reality in order to develop and plan practices.

If one believes that reflection improves practice, then one should pursue habits and practices to develop that skill.

5.3.7. Connecting documentation with reflective practice

Previous analysis showed teachers' awareness of their role as educators, and also their commitment to important attitudes and behaviors related to professional development and improvement of teaching and learning processes. Technology was also contemplated and most of them agreed that technologies change practices.

Now we will investigate their view about how documentation processes and reflective practice relate to each other. Our belief is that the former facilitates and helps to develop the latter. And this is exactly the purpose of our study.

About 85% of the teachers agree that the two processes are related to a tendency that older teachers agree with more (only 63% of the teachers up to 30 years old agree with this statement). In addition, the degree they have seems to make a difference too. About 83% of the teachers with a bachelor's degree agreed with this statement, compared to 100% of the teachers with a doctoral degree (even though this last group only has 4 teachers).

Fewer than 50% of the teachers (49%) think about the positive and negative influences of their previous teachers, and also fewer than 50% of them (47%) consider their experience as a potential topic for research.

In the end, the most influential variable was the attendance of an ICT course. A teacher's continued learning through courses focused on technology

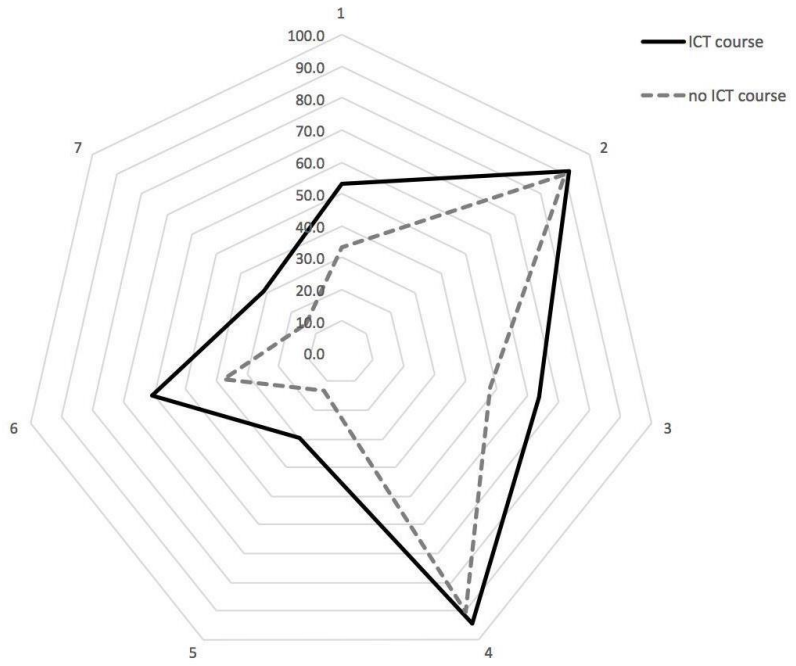
resulted in a higher percentage in basically all the data investigated. This certainly is a powerful message for the government and deserves additional investigation.

The graph below shows a correlation of 7 main pedagogical attitudes (listed below) *with* and *without* ICT courses.

Pedagogical Attitudes

1 - proactive attitude towards improving practices
2 - belief that digital resources change practice
3 - technology use in daily practice
4 - perception of reflective behavior
5 - use of diverse pedagogical practices that use technology
6 - planning practices
7 - use of digital media to assess students

Graph 2. Performance with and without ICT course



As we can see, the solid line indicates teachers with some sort of ICT course. This line forms a larger shape (heptagon), connecting points referring to higher percentages. For example, vertex 1 “proactive attitude towards improving practice” indicates a frequency of about 55% for the group of teachers *with* an ICT course and about 35% for teachers *without* such courses.

This overall results matched the extensive quantitative research by Brasilino et al. (2018): a) teachers use more ICT to prepare classes than in activities with

students, which the authors relate to a lower and higher level of digital literacy respectively ; b) institutionalized and informal training (continuing education) has a positive impact on teacher's use of ICT in their practice; this also includes interactions with other people and working groups; and c) existence of ICT available to teachers does not guarantee innovation in pedagogical practices but seems to encourage material engagement when teachers prepare classes and organize practices.

5.4. Focus group - investigating habits and beliefs through teacher interactions

As mentioned in section 5.4.2 ("methods"), our focus group had only 3 participants. Despite its inability to reveal reliable patterns, there were rich interactions between the participants that could be used as a reference to illustrate the findings from the other two instruments, the questionnaire and the interviews, as well as to corroborate discussions and conclusions.

We will refer to participant 1 as P1, participant 2 as P2, and participant 3 as P3[173]; the first two are math teachers, and the last one is a science teacher, although all teach both subjects depending on school demands. P1 is the only woman, who has taught for a longer time and is less knowledgeable about ICT in education. P2 is very proactive and engaged in improving students' achievement (for example, preparing students to apply for scholarships), and P3 is younger, has spent less time in the classroom, but integrates technology in his practice with more ease, motivation and frequency[174]. For these participants, we perceived a negative correlation between time as a teacher/age and use of technology in their didactic scene[175].

The focus group session involved a warm-up activity in which participants used colored *post-its* to write words related to *documentation*, *technology* and *reflection*. After this, they made sentences and shared their experiences and beliefs in light of their planning habits. Our intention was to unveil their perceptions

[173]P1 and P2 are both from the 3rd school district (3ª. CRE), and P3 is from the 2nd one (2ª. CRE) - refer to Figure 18.
[174]P1 has taught for 32 years, P2 for 12 years and P3 for 6 years.
[175]Margolinas and Riviere, 2005.

about the impact that digital technology has for teachers, their planning, their interaction with colleagues, their involvement with the school community, and mostly how it could be related (if at all) to documentation practices of their didactic scene (before, during, and after class). We looked for a connection between use of digital technology, documentation work and reflective practice.

We used Grounded Theory and Atlas.ti software to categorize and analyze the content that is shared below.

Brainstorming about central concepts: documentation, reflection, and technology:

When asked about participants' understanding of these three concepts (individually written down and then shared and discussed as a group) some relationships were clearly based on the search for a synonym, and for its "instrumental application", and others looked for a more complex link such as personal attitudes, behaviors and didactic processes. Table 15 below shows a tentative categorization of such words/relations.

Table 15. Brainstorm of central concepts as mentioned by participants.

	synonyms, applications, uses, instrumentation	**attitudes, behaviors, practice, opinion**
DOCUMENTATION WORK	*register, archive, memory, catalogue, source of information, portfolio*	*organization, past experiences, pedagogical content, challenging, planning of new practices ("paths")*
TECHNOLOGY	*media, robotics, movies, pictures, power point, pen drive, images, Google, tool, cloud*	*need to adapt, helps with the work, planning, improvement, convenient, challenging, frustration*
REFLECTION	*thinking, looking*	*rethink own practice, necessary and continuous, diagnose and reconstruction, change, commitment*

Connecting concepts with one's practice and pedagogical planning:

After sharing perception about these concepts, the participants tried to connect them with their own practice. Each one wrote down a sentence and then shared it with the group. Their sentences are translated as follows:

> **P1**[176]: "It's crucial! Documentation constitutes a collection of data that, with the use of appropriate tools, contributes to teacher planning, always with a lot of reflection."
>
> **P2**[177]: "[Planning should] be flexible and about student development. We should rethink teaching practices using the many technological resources in order to make teaching more dynamic and appealing to students; recording positives practices and reflecting about the unsuccessful ones."
>
> **P3**[178]: "Planning is necessary, or further still, fundamental! Adapting to new technologies is one way to rethink one's own practice, making a record of activities whenever possible."

Interplay and discourse

The group sessions lasted about 90 minutes preceded by an informal presentation and small talk, followed by a coffee break. During the sessions *per se,* teachers shared classroom experiences, students' situations and their attitude towards the use of technology in their practice.

Regarding technology, the participants drew attention to digital technologies, highlighting their need to learn more about how they can be integrated into their teaching and also to update their knowledge in order to deal with new demands. In fact, they mentioned how the use of technology facilitates classroom practices as well as students' motivation and active participation. P1 affirmed that during her studies she was not exposed to technology and for that reason she had to literally "catch up", by looking for, and trying new methodologies in her classes. On the other hand, P3 shared that technology is part

[176]In Portuguese: "...é indispensável! a documentação… formar um acervo de dados que com as ferramentas corretas contribui para o planejamento didático, sempre com muita reflexão."

[177]In Portuguese: "...flexível e voltado para o desenvolvimento dos alunos. Devemos repensar o modo de ensinar, utilizando os diversos recursos tecnológicos de modo a tornar o ensino mais dinâmico e atraente para o aluno, registrando as práticas positivas e refletindo nas práticas que não deram certo."

[178]In Portuguese: "Planejamento didático é necessário e, porque não dizer, fundamental. Adaptar-se às novidades tecnológicas é uma das formas de se repensar a própria didática produzindo sempre que possível um registro das atividades."

of his life and that he does not even imagine being a teacher and planning classes without technological devices and digital resources such as computer, projector, presentations, rotating pictures, etc. For this teacher, technology is part of students' life and there is no way out from contemplating technology in classroom practices[179]. All participants mentioned using technology to access pedagogical content and to enrich their practices.

> **P2**[180]: "(...) Firstly, with technology you can plan a more dynamic class, you can create extra activities with the help of technology, and also… search immediately for information, right? In a faster way."

Both P2 and P3 showed more proactivity when looking for and attending courses that involve technology in education.

> **P2**[181]: "... do you understand… so I mean… that is why it is important for a teacher to keep trying to attend courses, right, he (or she) gets new ideas, has contact with different wonderful people who, you know… will motivate you "Gee, check it out, I did this and so forth", "I used this…"

When mentioning **documentation**, all the participants recognized its potential; P1 and P3 are just getting more acquainted and confident about such practice, and P2 stated that documentation is already an internalized routine.

> **P3**[182]: "...I think that to document your work is, is … allows for the documentation and organization of your classroom activities … this is important … and it also allows for the exposure, the exposure of your work, right? … so that other people can also get inspired and try to do similar things, and even better, in other places."

> **P3**[183]: "Man, that's how it works, I don't have much of a habit of recording what I do (...) I rarely make a record…"

[179]He mentioned activities with QR code, rotating 3D shapes, and the *Kahoot!* App.

[180]In Portuguese: "Primeiro que você, com o uso de tecnologia você pode fazer a sua aula mais dinâmica, pode criar atividades extras com o auxílio da tecnologia, e também ... busca imediata de informações, né? Numa maneira mais veloz."

[181]In Portuguese: "... entendeu... então quer dizer... por isso é que é importante o professor estar sempre buscando fazer cursos né, vai pegando novas ideias, vai tendo contato com pessoas maravilhosas, que né... vão te motivar também… "Pô olha só eu fiz isso e tal" "Eu usei isso…"

[182]In Portuguese: "... eu acho que você documentar a sua atividade é uma, é uma ... possibilita a documentação... a organização da suas atividades em sala, ... isso é importante... e também possibilita a divulgação, a divulgação do seu trabalho né? ... para que outras pessoas também possam se inspirar no seu trabalho e fazer coisa parecidas, e até melhores, em outros lugares."

[183]In Portuguese: "Cara, é assim, eu tenho muito pouco esse hábito de registrar o que eu faço (...) raramente eu faço o registro disso."

> **P3**[184]: "I started to make a record recently. I started to make a record this year. I have become more conscious about it."
>
> **P3**[185]: "Man, I realized that it is important; it is important to make a record, as a way to disseminate and promote what you do in the classroom; it is a way to inspire other teachers to try new things in the classroom…"
>
> **P2**[186]: "Has it improved… no doubt about it dude! … Why? Because you save time with planning… by you having more … you save time, right? You do not waste time with paperwork because everything is already documented there. There is more time for you to reflect about what to do, think about your practice…"
>
> **P2**[187]: "In my case, for specific topics I really need to make an in-depth record, I am involved in both Math Olympiads and Astronomy Olympiads at school, so you have to make a record of everything that works and improves student performance."

One participant (P1) was concerned with intellectual property. She was certain that teacher intellectual production made inside the school belongs to the school and she was reticent about documenting and losing authorship.

> **P1**[188] (regarding documents and creative work): "… it is theirs… it is not your property… your intellectual property; as a teacher it is theirs. That is why I have always strongly resisted [documenting], because I am not willing to provide free publicity for the City Hall."

[184]In Portuguese: "Eu passei a registrar há pouco tempo, eu passei a fazer registro este ano, passei a ter uma preocupação maior com isso."

[185]In Portuguese: "Cara, eu comecei a perceber que é importante, que é importante fazer o registro, como uma forma de divulgar mesmo o que você está fazendo em sala de aula, uma forma de inspirar também outros professores a fazer coisas diferentes em sala…"

[186]In Portuguese: "Melhorou... sem dúvida pô! ... Por que? Porque você poupa tempo para planejar... você tendo mais... você economiza tempo né? Você não perde tempo com algo burocrático, porque já está ali documentado, sobra tempo para você refletir no que você vai fazer, na sua prática…"

[187]In Portuguese: "No meu caso, em determinados tópicos eu preciso fazer realmente um registro bem rigoroso, porque eu me envolvo na escola com a olimpíada de matemática, a olimpíada de astronomia, então você tem que fazer o registro de tudo aquilo que funciona e que vai bem para o desempenho do aluno."

[188]In Portuguese: "... é deles... não é tua propriedade ... a tua propriedade intelectual enquanto professor é deles, então eu sempre resisti muito a isso, porque eu não estou aqui para fazer propaganda para a Prefeitura."

Participant P2 on the other hand shared his motivations for documenting his practice and both him and P3 did not comment on or share P1's concerns.

> **P2**[189]: "I always innovate a lot, like rethinking many things, but I did not have the habit of making a record… then a new school year started and I had a hard time re-planning everything because I had to remember what I had done before… so that I could modify it … so, for me it was a need, like you said… and even more so, because I work on many projects. If I did not have a minimum amount of documentation, a minimum amount of organization, it would be more difficult… so I said to myself: "No… wait a minute! … this same horror story every year? Let's improve this!" and then I started to document, to organize things into folders and so on, because it is a much easier way…"

Participants P1 and P3 have been receiving institutional encouragement to engage in documentation work. P1 is finishing a continuing education course in which students are asked to build portfolios and register their planning; P3 is engaged in a school project to organize and document practices for all middle school grades; teachers are supposed to write content and share activities on a school site; P3 refers to it as a "manual". Documentation was also associated with registration of students' work, and despite frequent mentions of documentation as a memory of past practices and activities (just saving pictures of activities), there was reference to use for assessment and also content for undertaking research with the help of student teachers who attended P3's classes.

> **P3**[190]: "(…) I am not sure whether I have a record… I must do… I have a record here! I'll show it to you. So, I sing with students, I show it to them, and they have a great time, they love it! … and I started to use it as an assessment for them too…" (about work done with parody)

[189]In Portuguese: "Eu sempre inovo muito, assim, repensar muitas coisas, mas eu não tinha o hábito de registrar, então... virava o ano e eu tinha um trabalho do cão para replanejar, porque eu tinha que lembrar daquilo que eu tinha pensado antes... para poder modificar... então foi necessidade, igual você falou... ainda mais que eu trabalho com vários projetos, então se eu não tiver um mínimo de documentação, um mínimo de organização, dificulta muito.. aí eu falei "não, peraí pô... todo o ano essa doideira? Vamos melhorar isso aí!" aí que eu comecei a documentar, organizar por pastas e tal, porque aí fica uma maneira mais fácil…"

[190]In Portuguese: "(...)... Não sei se tenho o registro... devo ter... tenho registro sim! Vou mostrar para vocês. E aí eu canto com os alunos, mostro para os alunos, aí eles fazem uma festa, eles adoram! … e eu passei a colocar isso também como uma forma de avaliação para eles…"

Another advantage mentioned was that it facilitates sharing and collaboration among peers.

> **P3**[191]: (regarding documentation and an ICT course done with P2) "Definitely, it facilitates collaboration between pairs, right? … it is … a sharing of experiences and of information; and using technology allows for this in a faster and more dynamic way."

During their interaction participants spoke about their ideas and habits concerning a reflective attitude. They agreed about the importance of reflective practices to improve teaching and to evaluate the efficiency of processes, but the relationship between documentation work and reflection did not appear naturally: only when participants were prompted about how reflection, documentation work and digital technology could influence/determine/facilitate each other at the end of our group sessions. Another perception was that these teachers do consider their students (physically and cognitively), their environment, and also the available resources to plan and administer classes.

> **P3**[192]: (regarding perception and sensibility when teaching a class) "Oh man… when you look at pupils' faces… when you look at pupils' faces … then you realize when your class is boring… or tedious."

> **P3**[193]: "In fact, because classes are not homogeneous, they are not the same, so what works for one class, might not work for another… it really doesn't work! I have pretty different classes."

> **P3**[194]: "It works with one person and doesn't work with someone else… that is why I also mentioned there reflecting about practices that did not work… so you can modify them."

The teachers referred to reflection more as a mental/individual/unstructured practice rather than a documented, organized and shared one.

[191]In Portuguese: "Com certeza, facilita bastante a colaboração entre pares né? ... é... a troca de experiências, a troca de informação, e o uso da tecnologia proporciona isso numa maneira muito mais rápida, muito mais dinâmica."

[192]In Portuguese"Ah cara... olhando na cara dos alunos... olhando na cara dos alunos... então você percebe quando a sua aula tá entediante... esta chata."

[193]In Portuguese: "Até porque as turmas não são homogêneas, não são iguais, então o que funciona para uma turma não funciona para a outra... não funciona mesmo! Eu tenho turmas muito diferentes."

[194]In Portuguese: "Dá certo com uma pessoa e não vai dar certo com outra pessoa... então por isso que eu coloquei ali até o refletir nas práticas que não deram certo... para você modificar."

> **P2**[195]: "I always try to rethink all my practices (…) even when the activity is successful… we think about what we could do to make them even better."

Finally, when asking about their position concerning the relationship between these three main concepts[196] and how they were related to professional commitment, all three participants had positive comments. They were confident that a concern about documentation practices, integrating digital technologies in pedagogical activities to facilitate innovative and more student-centered environment, as well as a reflective attitude, could only be found in engaged and committed teachers. All three shared experiences and examples about colleagues who do not plan their classes ahead, who use the same material despite students' peculiarities and who are resistant to learning digital technologies and trying different teaching methods. They were also positive about technology as a facilitator of documentation practice, and about professional reflection being key for situational modifications of practice.

5.5. Semi structured interviews - a picture of documentation work

We interviewed 12 teachers from different backgrounds, school districts, grade levels and age groups and with a different length of teaching experience. The interviews were revealed as an important and valuable instrument to understand motivations and objectives inspiring teachers' practices.

We will refer to each participant as R1, R2, R3, and so forth. In total, we interviewed 6 men and 6 women. The equal division was by chance. We did not have representatives from school districts 3, 6, 7, 8 and 9 (CREs[197]).

All the teachers were middle school teachers. In table 16 below we show their content area and give an idea about the time they have been teaching middle schoolers.

The interviews followed a script in which big ideas to be discussed were listed (see appendix 13).

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[195] In Portuguese: "Eu sempre busco repensar as todas as práticas que eu faço (...) mesmo quando a atividade dá certo... a gente pensa o que pode fazer para melhorar ainda mais."

[196] Reflection, documentation work and digital technology.

[197] Refer to Figure 18 - City map with school districts' boundaries.

The 12 participants voluntarily accepted participating and were well aware about our object of research: documentation practices; organization, use, and objectives.

Now, we attempt to share teachers' voices, routines, motivations, beliefs and practices in light of our investigation framework.

Table 16. Teachers, school districts and content field.

Participant	Content and time teaching in schools
R1	Geography - more than 20 years
R2	History - more than 10 years
R3	Geography - more than 10 years
R4	Science - more than 10 years
R5	Portuguese - more than 15 years
R6	History - fewer than 10 years - currently on special class - reading and interdisciplinary projects
R7	Mathematics - more than 20 years - students with distortion age X grade level (currently teaching all content - homeroom teacher)
R8	Portuguese - fewer than 10 years
R9	Geography - fewer than 10 years
R10	Geography - fewer than 10 years
R11	Science and Mathematics - more than 15 years
R12	Science - more than 15 years

The teachers themselves, their professional surroundings and their students

With the exception of one teacher (R1), the participants referred to students with a caring and sensitive manner. They mentioned their challenging reality and their lack of family support. The teachers also demonstrated an attitude that revealed their social commitment and seriousness about their profession. Despite large classes, age-grade distortion, and disadvantaged school districts, the participants were concerned about content choices that fit their students, and also about motivational issues.

> **R3**[198]: "... there is one thing that I always say… during my first class of the year, in classroom when I start the year, which is an inspiration; often students have no idea about why they are at school; they do not understand the role schooling has in their life."
> R3[199]: "Each class has a profile; anything that is done in class is adapted and made suitable for that profile."
>
> **R5**[200]: "At times I have felt the need to bring up things that somehow raise their awareness... about a specific subject, about some problem they have been going through…"
>
> **R6**[201]: "... our planning necessarily has to contemplate students' learning skills, not only what they want to learn, but also how are they learning at that moment… of their personal journey..."
>
> **R7**[202]: "... lessons cannot be the same. I have to adapt them because classes are different, the way students listen and learn…"
>
> **R10**[203]: "... there is this sensitivity… [like] a temperature gauge for the day."
>
> **R11**[204]: "... for example, we have some classes that are a bit trickier than others, so when we teach a subject to such a class we use a game for example, we use a competitive activity; we always adapt depending on the group…"

The teachers were aware about some districts (and some schools) having more resources than others, even without having a real and official explanation for this. The precarious infrastructure was also mentioned, such as a lack of internet

[198]In Portuguese: "... uma coisa que eu sempre falo... a minha primeira aula eu, em sala de aula quando inicio o ano, é de inspiração; muitas vezes o aluno, ele não entende o porquê que eles estão na escola, porque eles não entendem o papel da escola na sua vida."
[199]In Portuguese: "Cada turma tem um perfil, qualquer coisa que é feita em sala de aula ela é ajustada e adequada aquele perfil."
[200]In Portuguese: "Em alguns momentos eu já senti assim a necessidade de trazer algo assim que provocasse a sensibilização... para um determinado tema, algum problema que eles tenham vivenciado…"
[201]In Portuguese: "... o nosso planejamento necessariamente tem que passar pelas necessidades de aprendizagem do aluno, não só nesse sentido do que eles têm interesse em saber, mas também no sentido de como ele tá aprendendo naquele momento.... do percurso dele…"
[202]In Portuguese: "... a própria aula não pode ser a mesma, eu tenho que adaptar porque as turmas são diferentes. a forma de acompanhar…"
[203]In Portuguese: "...têm essa sensibilidade... o termômetro para o dia."
[204]In Portuguese: "... por exemplo, a gente tem alguma turma que é um pouquinho mais levada então se a gente vai aplicar um conteúdo naquela turma a gente usa por exemplo game, usa uma atividade de competição (...) a gente sempre modula em função da turma."

broadband, lack of science labs, and school computers. Nonetheless, most of them were assertive and clear when making statements about flexibility and adaptiveness, for example when mentioning the work with low- cost material for science experiments.

> **R4**[205]: (regarding a manual with experiences using low-cost materials) "It has many chemical experiences with household items. You can do experiments with detergent, with hydrogen peroxide..."

> **R4**[206]: (regarding teaching the concept of gravity) "When you speak to them about gravity, you get a small ball and throw it on the floor… They start to understand that the concept is represented in this case, right?"

Lack of recognition, low salaries, and faulty public administration were all mentioned throughout their interviews. Actually, their commitment goes beyond the school grounds and job descriptions. They use their own computers, they pay for photocopies, they bring their own material to school, and they offer extra help after school hours to students willing to apply for scholarships.

> **R12**[207]: "I bought… I carry my own projector, I carry my own computer with me, in that way I am able to use it more…"

> **R8**[208]: "There are no computers, we do not have a computer lab, our school was built without a computer lab. The computers we received were of a bad quality (...) and we do not have computers provided by the city hall."

> **R8**[209]: "... Teachers who use computers bring them from home; they buy it with their own money."

Having set out the work environment and the mindset of the participants, we will now present their discourse about their engagement with digital technology in

[205] In Portuguese: "Ele tem várias experiências químicas e tal, com o que você tem em casa. Você pode fazer experimentos com detergente, com água oxigenada…"
[206] In Portuguese: "Quando você fala com eles de gravidade, você pega uma bolinha e joga no chão... Eles começam a entender que aquilo está ali naquele meio né?"
[207] In Portuguese: "Eu comprei... eu carrego o data show, eu carrego o meu computador, aí eu consigo usar mais…"
[208] In Portuguese: "O computador não existe, a gente não tem laboratório de informática, a nossa escola foi construída sem laboratório de informática. Os computadores que a gente recebeu, de qualidade ruim, (...) e a gente não tem computador fornecido pela Prefeitura."
[209] In Portuguese: "O professor que utiliza o computador traz o computador de casa, ele compra com o seu próprio dinheiro."

their practices, in their professional development and also in their production of pedagogical content.

Computers, internet and digital technology

As already mentioned, our participants were screened based on their perception about their use of technology and their documentation work. For this reason, there is no surprise here that almost all the participants shared their intense use of digital technology in their planning and their practices. During the content analysis, we recognized three main areas of engagement with digital resources: teachers use computers (and connected technology) to:

a) look for information

> **R4**[210]: "... software that allows you to download files (...) for example, here I have videos, I use these videos, you know … I teach about sustainability, about the ecosystem…"
>
> **R4**[211]: "There is one site that I really enjoy and use a lot, I get many slides from there… it is a biology one, I like really like "*sóbilologia.com.br*."
>
> **R12**[212]: "Everyone uses it (...) Pernambuco [Education] Secretariat's site (...) and you do not have to correct anything… the materials from Pernambuco are excellent, it is best material … that is available."

b) save useable material and students' work, to renew and try new, more engaging methodologies.

> **R3**213: "Yes, it is useful as a reference. Depending on the project, it works as a model so students can see what has already been done… even as a template for some changes."

[210]In Portuguese: "... um programa que consegue baixar os arquivos (...) por exemplo, aqui eu tenho vídeos. esses vídeos eu utilizo ele né... vou falar de sustentabilidade, de ecossistema…"
[211]In Portuguese: "Têm um site que eu gosto muito também, que eu utilizo bastante, que eu pego muitos slides lá... é o de Biologia eu gosto muito do "sóbilologia.com.br".
[212]In Portuguese: "Todo mundo usa (...) a página da secretaria de Pernambuco (...) você não precisa corrigir... é excelente o material de Pernambuco, é o melhor material ... que está disponível."
[213]In Portuguese: "Sim, isso serve até como referência, dependendo do projeto serve como referência para os alunos terem o que já foi feito, ... e até como base para alguns ajustes."

> **R1**2214: "...a memory for [students] too and also to use… and I try to reuse pretty much everything I save in some way."

c) organize and improve their planning routines.

> **R6**[215]: "(...) my starting point was my planning, seeing what I already had. Sometimes I used the same material, if I thought that it was appropriate and good. Sometimes I adapted it as needed; sometimes I discarded it if I decided it was not useful anymore for that group, but it remained saved. It was normally my starting point, the material that I had already set aside… and based on what was needed, I would produce new things…"

> **R8**[216]: "I think it would be great, such organization with digital work, organization… something you that have close at hand, that you can easily retrieve, easy and fast, because digital technology is much faster than searching among papers. I think all this is fundamental."

> **R11**[217]: "I think technology... I am convinced it facilitates a lot. If we are going to plan a class (...) the majority of people do that, they look for open files available on the internet, see what is interesting, add something, delete something else (...) I think that technological resources, the internet, help us to save some time, to present us with something we haven't seen before and find interesting."

The teachers use a variety of organization strategies and there were many levels of organicity and ecology applied to these documented resources. By organicity we refer to the characteristic of holding files that are "alive"; they are produced over time, they are used many times and, in different situations, they are

[214]In Portuguese: "... uma memória pra eles também e pra usar... e quase tudo que eu guardo eu tento re utilizar de alguma forma."

[215]In Portuguese: "(...) o meu ponto de partida no planejamento, ver o que eu tinha. As vezes eu usava o mesmo material se eu achava que era muito bom. As vezes eu adaptava de acordo com a necessidade, às vezes eu descartava se eu achava que não prestava para aquele grupo, mas continuava guardado, então era de onde eu partia normalmente, o material que eu já tinha acumulado... e de acordo com as demandas eu ia elaborando coisas novas."

[216]In Portuguese: "Eu acho que seria ótimo, uma organização com trabalho digital, uma organização... uma coisa que você tenha fácil, que você consiga recuperar informação, fácil e rápido, porque por meio digital é muito mais rápido do que procurar em papel. Eu acho que isso tudo é fundamental."

[217]In Portuguese: "eu acho que a tecnologia (...) eu tenho certeza, facilita e muito (…) Se a gente vai montar uma aula (...) a maioria das pessoas faz isso, procuram arquivos já disponíveis da internet, vê o que acha interessante, põe alguma coisa, tira outra (...) eu acho que os recursos tecnológicos, a internet tá ajudando no sentido de poupar o tempo pra gente, no sentido de apresentar coisas que a gente ainda não tinha visto e acha interessante."

combined, they might stand for a while and maybe be used later with another purpose. By ecology here we mean that they are connected: the files, the documents and the records "talk" with each other, they capture moments with students, they inspire papers, they communicate with a colleague, they model a process, they are used during an assessment situation.

Participants R2, R6, and R11 remixed their resources, reused them as pedagogical content for different years and different classes, and connected with other teachers to undertake research outside school, such as papers, books, video lessons, and to participate in external contests.

> **R2**[218]: "There we are producing a… the publication of a book based on students' writings…"
>
> **R6**[219]: "...there are videos... some videos I saved, there are pictures and records... of work that I did, this has (...) also, for example, once I created some teaching material, and I have that saved as well; there are many formats, so it varies, most of it is work I produced, but a part is collection of things that I use. Anyway, they are all resources right?"
>
> **R6**[220]: "with regard to taking advantage of my reflection about my practice, I have done it a few times. For example, [using] all the material from the music festival, I wrote an article with a teacher who was my university advisor."
>
> **R6**[221]: "… I have also had an experience of theoretical and professional reflection about my practice because I have kept in contact with Gisele and Cynthia from UFRJ [Rio de Janeiro Federal University] (...) I wrote an article, and I wrote a blog about my practice."

[218]In Portuguese: "Ali a gente tá produzindo um... a publicação de um livro a partir de textos dos alunos."
[219]In Portuguese: "... tem vídeos ... alguns vídeos eu guardei, tem fotos e registros, de trabalhos que eu fiz, isso tem (...) também, por exemplo, uma vez eu produzi material didático com... e aí eu tenho guardado também, mas aí o formato é variado, a maior parte é material autoral, mas tem uma parte que é coleção de coisas que eu utilizo, enfim, são recursos né."
[220]In Portuguese: "com relação a proveitos para reflexão de prática, eu fiz algumas vezes , por exemplo, todo o material do festival da canção eu escrevi um artigo em parceria com a professora que foi minha orientadora."
[221]In Portuguese: "...eu também tive uma trajetória de reflexão teórica e pedagógica em cima da minha prática porque eu não perdi o contato com a Gisele e com a Cynthia da UFRJ (...) eu escrevi artigo, e eu escrevi em um blog sobre a minha prática."

> **R11**[222]: "Exactly! It is self-marketing, but it is not about me showing off my work! (...) public school gave me a solid education (...) so I would like other teachers to see that it is possible and get inspired too "Ah! I can adopt this practice in my classroom too". Every time a teacher gets inspiration and bring these practices to the classroom, students benefit from it…"

> **R11**[223]: "... I actually have these records in the form of a lesson, in the form of a report, … but I also have photos, which are records of students' activities records, the results. There is also the issue about the materials produced afterwards, there are videos that I collect (…) one activity that lasted 8 minutes in each class turned into a publication, a book chapter (…) about practice in science classrooms."

Participants R2 and R3 teach at an experimental school called *Ginásio Carioca*[224], where students receive computers, classes are smaller, there is a tutoring program, and internet is open to teachers and students. We were able to observe a discourse that reflected a more intense use of collaborative work, and an existing school site where teachers and students access content and variety of resources such as movies and graphs, and general information.

> **R2**[225]: "... what I post for them here (...) I also use Google Classroom, but here in Google Classroom I have lessons and I only tell them that it is on the website, because on the website I have more flexibility."

[222]In Portuguese: "Exato, é um marketing pessoal, agora assim não é aquilo de que eu quero mostrar o meu trabalho! (...) um colégio público que me deu uma boa base (...) eu quero que outros professores vejam que é possível e que se inspirem também "Ah! eu posso levar essa prática para a minha sala de aula", toda as vezes que o professor se inspira e leva as práticas para a sala de aula, o beneficiado disso é o aluno…"

[223]In Portuguese: "... eu tenho aqueles registros mesmo né que é a aula, que é um relatório, ... mas também tenho as fotos né que são os registros das atividades dos alunos, dos resultados, tem a questão das matérias que são produzidas depois, tem os vídeos que eu vou agregando (…) uma atividade que durava uns 8 minutos em cada turma e aí virou depois um trabalho, um capítulo de um livro (...) sobre a prática de ciências."

[224]Ginásios Cariocas are a model of middle school instituted in 2011 in the city of Rio de Janeiro. It focuses on students' autonomy and was planned to offer academic excellence and new forms of interaction. Those schools have extended hours and differentiated activities such as "life project". Also, the teachers are all full time and the content is integrated. Students choose electives that are designed to stimulate students' creativity and special skills development. (http://www.rio.rj.gov.br/web/sme/exibeconteudo?id=2285016)

[225]In Portuguese: "... o que eu posto pra eles aqui (…) o Google Classroom eu uso também, só que aqui no Classroom eu tenho as aulas, e eu só aviso para eles que estão no site porque o site me dá mais mobilidade."

> **R2**[226]: "This school, it has a block referred to as advisory period, which I know is a space where students have access to computers and the internet, because they use their cellular phones, and they have a week. During the week they have a lot of time available like this. I am able to think about this activity for them to complete during the week (…) sometimes I work with flipped classroom."

Nonetheless, we also observed R5 and R12 who teach at regular schools but provide access to their own mobile internet connection when needed, to undertake specific work with students, such as viewing a picture or answering a quick survey.

> **R5**[227]: "I tried to, I mean, I set up a WhatsApp group with this 7th grade class to be able to… to facilitate some things (…) but this year I tried… to make a Google Form with exercises; I did it using Forms in order for them to be able to find the answers (...) I have an old one, and another old one that I had at home... I brought it" (about bringing her tablets to use in class with her students)

Teachers develop digital content and we could say that most of them use it on a daily basis. The vast majority mentioned presentations to be used with projectors in class. Some science teachers highlighted the usefulness of digital technology to demonstrate 3D shapes of human organs for example.

> **R4**[228]: "And that is cool… I started to realize that in Biology and Chemistry, when you talked about certain things and only used to write on the board, that became tedious; now, when I projected the human system … you notice that students are more focused."

Participant R7, who is a homeroom teacher in a resource room, presented impressive documentation work with daily folders, each being composed by motivational videos, presentations, short movies to introduce content, and work to

[226]In Portuguese: "Essa escola, ela tem um espaço de mentoria, que eu sei que é um espaço onde eles têm acesso à internet, acesso a computador e a celular, porque eles acessam o celular, e eles tem uma semana, durante a semana eles têm muitos destes tempos, eu consigo pensar essa atividade para eles realizarem durante a semana (...) eu geralmente faço a coisa da sala de aula invertida…"

[227]In Portuguese: "Eu fiz uma tentativa, quer dizer, criei um grupo de WhatsApp com essa turma de 7o. ano para poder... facilitar algumas coisas (...) mas eu experimentei esse ano... criar o questionário no Google de exercícios, que eu coloquei no Forms, porque aí eles podem ter a resposta (...) eu tenho um velhinho e outro velhinho que tinha lá em casa… eu trouxe."

[228]In Portuguese: "E isso é legal… eu comecei a perceber que em Biologia, Química, quando você falava de alguma coisa e você só escrevia no quadro, aquilo se tornava um pouco massante, agora quando eu projetava o sistema... essa coisa da gente perceber o aluno mais focado."

be completed by students. In addition, he and many others provide students with access to different kinds of social media, as part of which they share work, instructions, answer questions and show pictures of students work (culminating projects).

> **R7**[229]: "It is on a daily basis… because I teach differently, my class is for remediation, it does not follow a regular schedule, so some days I teach Math and Portuguese and on other days I teach Geography and Math, so I adapt things, I teach everything."

Engagement with digital technology and computers was basically a characteristic of all the interviewees, and there were a myriad of examples and resources being digitally documented and registered. However, we did not find so much evidence of records contemplating, in writing, reflection and transformation. When asked about this, most of the teachers seemed to have a somewhat uniform explanation: they reflect as they teach, they reflect as they plan, their reflection is recorded on their minds and the desired or the recommended modifications would be certainly done insofar as material/content is used again.

Three cases stood out concerning their engagement with technology: R9 showed a very basic, amateur level when dealing with computers, technology, the "cloud" and interactivity; R1 was not fond of incorporating technologies in her practice, and R8 blamed public administration and lack of support (money and time) for her limited access to technology and, as a consequence, almost nonexistent documentation practice.

Overall we can say that most of the interviewees do engage with technology, document pedagogical resources (which were saved directly from the internet, remixed or developed by them), benefit from digital resources to enhance their teaching, try new methodologies (such as collaboration between students and online assessments), and benefit from the engagement with technology; minds are extended as they rely on knowledge developed and transformed with the use of such resources (extension of memory, computation with and access to big data, for example) and minds are also distributed as existing resources (the web,

[229]In Portuguese: "Ele é por dia... porque eu sou professor diferente, o meu é projeto, não é regular, então tem dias que eu dou aula português e matemática, tem dias que eu dou aula de geografia e matemática, então eu vou cuidando, eu dou aula de tudo."

interactivity, collaboration, accessibility, reach) enable new behaviors (documentation genesis), new attitudes (start developing research from practice, reuse material), new actions (start using digital media to communicate, collaborate), and new practices (digital production to assess learning such as parodies and movies).

The use of computers is associated with words such as “time saving”, “organization”, “planning”, “research”, and “pedagogical content”.

When asked to see their computer folders, we observed pretty diverse practices, some of them questionable regarding their efficiency. Some examples are described below:

- R2 and R6, both history teachers, have their main files organized by themes and not by years or by grade level. They have folders such as “Africanism”, “Dictatorship”, “Socialism and Capitalism”, “Latin America”, and “Slavery”.

> **R2**[230]: “For example, I have “lessons” [folder] here, then I choose this school here because there are many schools (...) then I select “activities” and under “activities” (...) I have here, “colonization”. After that, under “colonization” I have many images for example…”
>
> **R6**[231]: “This one here is another presentation, Capitalism vs. Communism.”

- As mentioned before, R7 has his main folder already organized by days. Inside each day, there are files referring to movies, presentations and classwork. When asked about how to find specific content, the teacher answered that all documents are saved with a “self-explanatory” name. In this way, with a simple search he could find related files.
- R4 organizes by years as he is most concerned about using the same documents with the same group of students, when teaching different grades. He had a sort of “rotation” every three years for tests, projects and quizzes.

> **R4**[232]: “...I separate very important things in folders; I create a few folders per year, and keep naming them 2012, 2013, …”

[230]In Portuguese: “Por exemplo, eu tenho aqui "aulas", e aí eu vou nesta escola, são várias escolas (...) ai eu vou em “atividades”, e em “atividades” (…) eu tenho aqui, “colonização”, aí eu vindo em “colonização” eu tenho as imagens, por exemplo.”

[231]In Portuguese: “Este aqui é uma outra apresentação, Capitalismo X Comunismo.”

[232]In Portuguese: “... coisas muito importantes eu separo em pastas, eu crio umas pastas por ano, vou separando 2012, 2013...”

- R9 had randomly saved and had very disorganized files. Basically, he looks for ready material and does not produce his own creative work, relying more on textbooks.

> **R9**[233]: "I get it from the handout, I fill out the handout with them… it is a textbook. When I know that it's not in the textbook… it is from the internet. I take a summary of everything and write it on the board."

- R10 has everything in the format of presentations. She does not differentiate between the level of material for public and private schools, such that she does not have different folders for different schools; she only adapts the level of the classroom discussion. Her presentations are organized by units and she utilizes them every year, making only a few necessary adaptations.

> **R10**[234]: "Well, all my classes are presentations, see (…) I save all my records from old schools (...) I do not differentiate between public and private schools… the same level of quality."

- R11 organizes by years and by areas of interest as she is engaged in many projects, not only at school but outside as well.

> **R11**[235]: "I like to organize by year. For example, this is from school, and this one here is my personal one, which I also divide up by year (...) these ones are not related to school, like Income Tax. These two are books that I am organizing…"

There appears to be a consensus about the advantages of using computers in education in general, and more specifically in the creation of teachers' work. Their intense use of computers and digital resources most likely favors documentation work.

Transformation and improvement

[233]In Portuguese: "Eu pego da apostila, concluo a apostila com eles... é livro didático... Quando eu sei que não tem no livro... é na internet. Eu pego aquilo resumido mesmo e passo no quadro."
[234]In Portuguese: "Então todas as minha aulas são apresentações, ta vendo (...) eu guardo todos os meus registros das escolas anteriores (…) Eu não tenho diferenciação de escola pública para privada... o mesmo nível de qualidade."
[235]In Portuguese: "Eu gosto de organizar por ano, por exemplo, esses são da escola, e eu tenho esse aqui, meu pessoal que eu também divido por ano (...) são coisa que não são direcionadas para a escola, tipo Imposto de Renda. Esses dois livros aqui eu estou organizando…"

When prompted about the relationship (if any) between documenting practice, transforming resources and improving teaching, some teachers showed considerable proactivity remixing material, creating original content, modeling resources, depending on their target audience and school reality, and also using documented work for other purposes. For example:

- R2 uses students' end-of-year work as classroom content to start a unit the following year. He has also integrated music with history and won an external contest with his students, having been awarded with an extension course at a very prestigious university in Brazil (among other prizes).
- R11 has integrated science with arts, English and Portuguese to develop comprehensive material on sources of energy and has also won a contest, receiving a field trip for her students, which was also documented …. In addition, R11 shows persistence when transforming documented work into books and papers.
- R6 has used his documented material as an inspiration to develop, write, act and record a series of video classes for an educational channel.
- R5 used her work with students to write her master's thesis.
- R12 participates in a research group (university graduate level) as part of which she transforms school work into research papers.

The teachers' concern about improvement was shown when they modified already documented resources to produce an updated document with new concepts, definitions and current affairs. The teachers were aware of changing terminology and affirmed that they constantly search on the internet for "better" material, such as a friendlier layout, clearer explanations, and more reliable information. More than one (R4, and R12 at least) mentioned the same site as a valuable and often useful resource.

Regarding modifying documented work and transforming it for outside school purposes, R4 shared an intriguing and surprising perspective when questioned about the use of documented work for "outside" school purposes, such as contests, papers and professional writing, R4 claimed that such practice could jeopardize the attention dedicated to the students and the focus on the school work. He demonstrates devotion and commitment to his students, their learning,

and the planning involved; this teacher mentioned not being so fond of personal marketing…

> **R4**[236]: "I never have, who knows… I don't know if I would stray from my objective. I think it would be a mess… doing it not for education primarily but rather more influenced by financial purposes (…) I am afraid about that."

After an overview of teachers' professional practice and personal beliefs, and after sharing how they engage with digital technology during their documentation work, its uses and extensions, we were then interested in understanding their conception about what defines a reflective teacher and also their perception about them being engaged in reflection.

Reflection

In alignment with the survey and focus group findings, the participants in the interview also recognized reflection as constitutive of a committed teacher. They called it necessary and part of the profession. We did not register practices of registering reflective notes in writing. Most of the teachers affirmed that they reflect all the time, during the entire didactic scene; while planning and selecting resources to be used during class and classroom discussions, and after class, the latter mostly happening individually and mentally. However, one can defend that teachers' beliefs and attitudes as well as the way they engage with technology are demonstration and proof that reflection is being in fact done all the way through. We did not, however, see documents (or schemes of usage) being written down with memos about "next steps" or any reference to what worked and what ought to be changed or avoided.

> **R2**[237]: "... there we work from the perspective of a project that were refer to as practice and reflection, which involves this doing and thinking about doing the whole time."

[236]In Portuguese: "Eu nunca fiz, sei la, não sei se eu vou fugir do meu objetivo. Acho que pode fazer uma confusão… estar fazendo aquilo não para a área da educação mas mais financeira entendeu (...) eu tenho medo disso daí."

[237]In Portuguese: "... ali a gente trabalha numa perspectiva de um projeto que a gente chama de prática e reflexão, que é esse fazer e pensar o fazer o tempo todo."

> **R6**[238]: "... this attitude is important because it involves self-comparison (...) I believe it is very relevant for you to remind yourself about what you have done, about what you have become… gosh… what you do not do anymore… actually being self-critical sometimes... "Look! I used to do so much …", "I used to have such a disposition that I do not have anymore (…) there is an emotional side, for example… I remember those students... So it's important and has to do with my professional development."
>
> **R11**[239]: "well… there are some things… most of the time I keep it in my head actually, because when I open a file, for example, if I retrieve something from 2018 "…Oh! Last year this one here did not work…, or this one is not worth repeating."

Connecting the concepts

Our group of 12 teachers (more specifically 11, because R1 was more like an outlier, not in unison with the others in terms of beliefs, practices and objectives) demonstrated confidence when admitting that technology is (and should be) part of teaching - learning processes nowadays; they also recognized the fundamental role that technology has in the teaching profession; they correlated it with words such as *planning*, *searching*, *remixing*, *modeling*, *adapting*, *transforming*, *exposing*, *sharing*, *collaborating*, *advertising*, *organizing*, *allowing*, *and expanding.*

Teachers said that reflection was all around. In fact, the teachers demonstrated some surprise when asked about the "time to reflect" or about "the place to write down a reflection". Again and again, they were assertive in saying that reflection is *ongoing*, that it is fundamental, and also that they kept reflection results in their minds, there being no problem with this.

[238]In Portuguese: "... esse gesto é importante porque ele é comparativo para si mesmo (...) Eu acho muito relevante você lembrar do que já fez, no que você se transformou... poxa... o que você deixou de fazer... até fazendo uma autocrítica às vezes... "Olha, eu fazia tanto... ", "Eu tinha pique para fazer e não tenho mais (...) e tem uma dimensão afetiva por exemplo... eu lembro desses alunos... Então isso é importante, isso tem a ver com o meu crescimento profissional."

[239]In Portuguese: "então... tem algumas coisas... a maioria das vezes fica na cabeça mesmo porque aí quando eu pego o arquivo, por exemplo peguei uma coisa lá de 2018 "... Oh! No ano passado isso aqui não funcionou…, ou isso não vale a pena refazer."

R5[240]"On the computer it is a practical issue, right? (...) I always teach similar classes (...) so in this way I use it as a reference (...) it is a comparison (...) even if the classes are different, we have curriculum a reference to go back to, so I reuse it. "I used this approach for this topic but this method was not so good", so I keep the content but change the method (...) I believe it is important to save the material that we create... I believe it makes all the difference in our career. So, firstly I think: saving because you need to keep your files on the computer, put them on a pen drive and bring them to school to print… afterwards for you to refer to… I think that even going over your past work (...) it is essential, right?

R5[241]: "I believe registering is important because our memory can betray us (...) I believe it also acts a bit as a repository to see what worked well and what I did wrong (…) it is my material, which I created. I also think it brings back other memories from past moments as well (...) I think there is an emotive issue, there is a matter of practicality because if it is on the computer it is saved and I can retrieve it at any time, whether to make my life easier or even to criticize and not use it again. I think that is it: it is emotive, it is material that I created, which keeps a record of moments with that group, it is practical."

R6[242]: (about documentation) "It came up from my own practice because we leave university and come face to face with the classroom. Our work involves a lot of creation.

[240]In Portuguese: "No computador, é questão prática né? (...) Eu sempre pego aqui turmas parecidas (...) então assim eu uso como referência (...) é uma comparação (...) mesmo que as turmas sejam diferentes a gente tem um currículo, um fio condutor para voltar, eu reuso. "Eu fiz uma abordagem desse assunto desse jeito mas esse meio não foi legal", então eu vou manter o conteúdo e vou trocar o meio (...) Eu acho que é importante a gente guardar o material que a gente produz... eu acho que faz toda a diferença no caminhar da gente, então eu acho que primeiro: para guardar porque você precisa salvar no computador, botar no pen drive e trazer pra escola para imprimir... depois para você consultar... eu acho até que consultar assim a trajetória (...) é a crítica né?"

[241]In Portuguese: "Eu acho que registro é importante porque a gente pode ser traído pela memória (...) Eu acho que também funciona um pouco pra este repositório de ver o que já deu certo o que eu já fiz que não dá certo (...) é um material meu, que eu construí, eu acho ate que traz outras memórias também de outros momentos (...) Acho que é uma questão afetiva, uma questão de funcionalidade também porque tá no computador está guardado e a qualquer momento eu posso lançar mão daquilo, seja para facilitar a minha vida, seja pra criticar e não usar. Eu acho que é isso, é afetivo, um material que eu produzi, que guarda os momentos com aquele grupo, é funcional."

[242]In Portuguese: (sobre documentação) "Surgiu da minha prática mesmo porque a gente sai da universidade e encara a sala de aula. O nosso trabalho é muito autoral. Ainda que a gente se baseie em materiais pré elaborados, ainda que a gente se espelha deliberadamente em outros professores, no momento que nós assumimos esse protagonismo, temos que fazer esse planejamento, esse processo é muito autoral (...) . é o que eu acredito de educação."

> Even if we use other pre-made resources, even if we deliberately use other teachers as a role model, whenever we accept this role, we have to do our own planning, this process involves a lot of creation (...) [reflects] It is what I believe about education."
>
> **R6**[243]: "Because I realized that it was not about my specific job [self-marketing], it was about fighting for and defending public education, about sharing with other History teachers, about inspiring other professionals…"[244]
>
> **R6**[245]: "Memory and reflection about practice."

The interviews produced rich and meaningful material about teachers´ perceptions concerning documentation work, reflective practice and their relation with digital technology. The focus group results and some indicators from the questionnaire were corroborated. Once again, despite the lack of evidence about documentation work and enhancement of critical reflective practice, there was undeniably a reflective attitude guiding planning and performances as well teacher choices and pedagogical activity.

Subsequently, we will discuss our results based on our theoretical framework, highlighting our findings and teachers' discourses and behaviors concerning our three main areas of investigation: documentation, reflection and digital technology.

[243]In Portuguese: "Porque eu percebi que não era a questão do meu trabalho, era de defender essas bandeiras da educação pública, de troca com colegas de história, de inspirar colegas…"

[244]At first this teacher refrained from using social media to share and show his work with students because he related such practice to self marketing. After some time he said he realized that social media could help other History professionals and also facilitate the exchange of ideas and good practices.

[245]In Portuguese: "Memória e reflexão da prática…"

6
DISCUSSION

"Unless you believe, you shall not understand".
St. Augustine

Having presented our findings (chapter 6), we can now use the data and our findings in a final discussion.

6.1.
Connecting the questionnaire data to the focus group and interviews findings

The questionnaire informed about teachers' perceptions and beliefs about themselves and about their practices in relation to documentation work and reflection through the use of digital technology. The high percentages found in many specific investigations, as we stated before, can be explained due to "pre"-screening when selecting the teachers (selective sample). In order to better understand the motivations that could lead us to a conclusion, we decided to concentrate our research in the participants that considered themselves engaged with the use of digital technologies in their practices, not only to plan but also to develop, register and assess classroom activities.

The results obtained from the survey informed some research outcomes (chapter 6) but both the focus group and the interviews highlighted the importance of a few points and introduced new ones. Based on teachers' interaction during the focus group and also on the teachers' attitudes, actions and discourses during the individual interviews, our interpretation prompt (in us) certain discussions, suggestions and concerns centered on our main areas of interest.

Reflective attitude

Firstly, teachers manifested an understanding of what a reflective attitude entails and which actions and beliefs could correspond to it. We observed this in the survey results as well as in teachers' discourses. We point out though that reflection is indeed a non-unanimous concept, with many levels inferring different actions and beliefs. Most of the teachers related "reflection" to the idea of "thinking through" and "looking back"; they are conscious about their target audience and their specificities. They look for meaningful pedagogical material to motivate their students and they mentioned *flexibility* and *changes* in order to

achieve educational goals. They also mentioned that their reflection is “in their minds”, they “know what went wrong”, and that they reflect “all the time”, not showing, though, more structured reflective practice such as note-taking for further reference.

Based on the references from Table 1 (section 3.2.1), we observed descriptive and technical reflections in many testimonies but fewer critical and subjective ones (Jay and Johnson, 2002, and Valli, 1997). In the smaller group of teachers (interviewees), we highlight teachers R2 and R6, who were pretty vocal about content chosen, instruments used and methodologies applied. They displayed constant consideration about motivating students, the quality of their pedagogical processes, and the meaning and the importance schooling has for their students. These teachers displayed some concern about their students’ development of critical skills. They commented on the changes implemented from one year to the next based on what was documented, and also that the internet helps with such modifications. The teachers mentioned looking for “better” material, with friendlier layout, clearer explanations, and more reliable information. There was a true concern for students and the teaching-learning process. Based on their discourse, it seems that their practices involved a myriad of teaching methods[246], and assessment was formative, diverse and comprehensive. Their discourse and the observed material suggest their commitment to public education and the empowerment of the individual to become a conscious, active citizen. We observed some activity on the fifth level of the Sterling’s Levels of Knowing pyramid (2010, p.21) when teachers’ actions reflect their paradigms and worldview.

In addition, teachers claimed to reflect *in* and *on* action (Schön, 1993); however, we did not observe them in action. Also, the teachers did not share many situations about reflecting *about the reflection on action* (see table 1). R10 affirmed sometimes writing notes on her presentations concerning future practices and R2 said that he “knows” what worked and what did not; what to add, to change, or to develop for his future interactions; for that reason, he mentioned “students’ eyes” and “classroom dynamics”.

[246]flipped classroom, group work, presentations, collaborative work and individual work, etc.

It is interesting to resume the discussion defended by Argyris and Schön (1974) and Sovacool and Hess (2017) insofar as both studies mention a dichotomy, a sort of "movement" to be desired and acknowledged when seeking reflective behavior. Argyris and Schön (1974) defined two models for reflective practice and affirmed that the second one (Model II) consists of an adoption of a new framework, whilst Model I is when the current strategies remain. We could defend that an engagement with connected digital technology installs a new framework, but P1, R1, R8, and R12 for example, did not seem to have made this innovation part of their practices insofar as, based on their discourse and the material observed, their practices did not seem to contemplate innovative pedagogical processes allowed by such resources. Clearly, it is not within our scope to evaluate such attitudes (or lack of); we well know that, as shown in the historical context section, Brazilian public education, and its teachers strive for recognition, resources, planning time, and better working.

In addition, in the work by Sovacool and Hess (2017) on theories in action, they defined them as the theories that link thoughts to actions, they differentiated between *espoused* theories and theories *in use*. We noticed a disconnection in these theories in our investigation. The teachers' espoused theories beautifully describe an ideal professional, with assertive beliefs, objectives and actions; however, our sessions, interviews and observation of documentation work lead us to believe that there were many contradictory realities there. The teachers' discourse about documenting practices and organizing material to be reused, transformed and accessed were put at test when some demonstrated unwillingness to show their files and their computer directories. For example, R3 produced an extensive discourse about his skills and his professionalism when documenting and registering his practice. He dedicated 80 minutes of his planning time to portray to us "his" critical, interactive, and empowering practice, however, he insisted that his computer was running out of battery and that in the whole school there was not a single adaptor or plug that worked. He failed to provide support for his positions with any evidence that his espoused theory matched the theory that was in use. On the other hand, we could take R2, R6, and R7 as good

indications of such agreement between *said* and *done*[247]. In light of this, we might want to deepen our investigation at some point in the future: based on the survey results, the majority of the teachers recognize not only that documentation favors reflection (85%), but also which attitudes disclose reflective behavior (table 6), and yet only about half of them actually document pedagogical actions. This suggests specifically the disconnection mentioned by Sovacool and Hess (2017), even if we can attribute some of this result to circumstances such as lack of time and support (mentioned by R8), and deception with teaching work (mentioned by R10).

Connected technology

Secondly, a large group of teachers claimed they use connected technology to look for content material (92%[248]), which could be used in their classes, modified, or just utilized as inspiration for creative work. Based on the collected data, and focusing on our object of study, which is teacher documentation work, we were able to listen about teachers' activity and how they said they engaged with digital technology in their documentation work. Computers participated on the processes of instrumentation and instrumentalization (Rabardel et al. 2001, 2003, 2005) that resulted on teachers' digital documentation work.

As such digital instruments, computers support documentation genesis (Gueudet and Trouche, 2009a; Drijvers and Trouche, in press). The documents are mentioned in the sense of being *archives* for past and present resources, class materials, and students' work. The documents also reflect teachers' professional *memory* and their trajectory, acting as a *portfolio*, besides constituting a *pedagogical tool* that includes some evidence of didactic scene steps (Margolinas, 1995, 2002, 2005). Based on teachers' discourse, we understand that the use of digital technology for the genesis and development of teachers' documentation work is grounded on a reflective attitude with varying levels of complexity, with varying levels of criticality, resulting in deeper transformations or otherwise.

[247]Despite not observing the teachers in action, we had access to their files with videos, documents and students' work. The videos, for example, showed classroom interactions, parts of formative assessments, and students in action. The content of the observed material also indicated teachers' reflective attitude when choosing, changing, transforming, editing and using such content.
[248]Questionnaire question 15.

The genesis of digital documentation connects, extends, and distributes. It allows what was not feasible before: different practices and products; interactions, movements, combinations and inclusions.

Education and development

Thirdly, participation in external courses related to technology and education (whether specifically or not, institutional or informal) tends to be correlated to more proactive teachers regarding engagement with digital resources and the sharing of practice, despite this aspect not being frequently mentioned during their interviews but in the survey. For example, based on the bivariate analysis, we can use these results for illustration:

- *Use of digital media to plan classes*:
  with ICT course - 82%, and without ICT course - 63%
- *Use of digital media to communicate results of the learning process:*
  with ICT course - 53%, and without ICT course - 30%
- *Sharing of ideas and experiences for professional development and improvement of practice:*
  with ICT course - 68%, and without ICT course - 33%

Despite this, all the interviewed teachers who had a logically[249] organized documentation work (the ones who showed us some evidence - for example, computer files and directories) mentioned either their personal (and their resulting professional) interest in technology (P3, R4, R11), or some sort of vicarious help; the most proactive teachers mentioned external courses (R2, R7, R12), assistance from relatives and friends (R10) and colleagues (R9) as key for their familiarity with tools and their affordances[250]. This result about the importance of continued education concerning the use of ICT in pedagogical practices as well as the importance of help from peers and study groups corroborates with the findings from the nationwide quantitative survey by Brasilino et al. (2018). We agree that

[249]We will consider "logically" organized as ones with a rationale underlying teacher's choices when organizing their documentation work. For instance, ones organized by years, by days, by specific topic and so forth. We understand that such organization is essential for retrieval, reuse, remix, transformations, and sharing of such materials.

[250]For more on affordances, see Gibson, 1977.

computers and the web do not *per se* result in proactiveness in undertaking documentational work and innovative practices (Brasilino et al., 2018); however, it seems to constitute a *sine qua non* condition for documentational genesis insofar as it seems to be the only resource capable of affording all that is desired from a document nowadays: memory space, archive, variety of displays, convenient organizational possibilities, virtual space, flexibility, portability, among others.

6.2. Additional points

Firstly, we would like to clarify some discrepancy between the survey and interview results. For example, in table 4 we find about 70% of the teachers adapting and reusing material and basically all our interviewees claimed to do so. This is because the teachers' who offered to participate in the interview process were more likely the ones more engaged in such practices.

Another point is that for both groups (questionnaire participants and interviewees), we observed similar results concerning attitudes, such as discussing practice with colleagues after a class or making written records about observations for future use of resources. Such attitudes were rare to find. We believe that such findings are influenced by availability of common planning time, and also time in between classes or during the day to record notes, which is not easy to find, despite teachers' willingness.

Furthermore, research about processes usually involves a large time span and a proximity with the object of study, usually with many interactions. Our focus in this investigation was, when investigating the genesis of the documentation *process*, to explore teachers' perceptions and beliefs[251] about their documentation *work*, and their willingness to understand about its composition and usefulness. We listened to what the teachers told us, we looked at what the teachers showed us, we tried to perceive motivations, sentiments and beliefs based on their movements, the tone in their voices, and their overall behavior… Based on these 11 hours of discourse and a couple more hours of interaction in person,

[251]The explorations of such perceptions happened through both interviews and content analysis, this last one done with the use of the software Atlas.ti.

we observed some interesting positions, motivating practices and suggestive situations that are discussed below.

School structure seemed to facilitate (or discourage) documentation practices. Full-time teachers and schools that offered internet connection, supportive administration, and a favorable planning schedule positively influence the inclination and motivation to develop and document pedagogical resources. R2, R6, and R11 are full-time teachers working at schools that offer an extended schedule[252] (*Ginásios Cariocas*) and they were the ones who developed extensive, diverse, organized, ecological and organical documentation work. R5 mentioned the school director encouraging digitally planned projects and practices shared with school stakeholders. R12 also mentioned administration's proactiveness in involving teachers in the production of written material grounded in teachers' practices. In this regard, from the materials available we observed that documentation work were related to their professional practice (videos, presentations, animations, samples of students work, etc.). The teachers engaged in many projects such as the writing of a book, voluntary work, and interdisciplinary projects. They showed us files with corresponding frameworks and activities.

There are some teachers who "give back"[253] their documentation work in the form of book chapters, research papers, posts in related social media, and communications to parents, students and administration; however, this group turned out to be about ⅓ of the total interviewees. It looks like the reflective level is also connected to what was mentioned in table 8: documentation done with "pre-practice" and "practice" objectives (planning classes, searching for and transforming content, for example) suggests a more instrumental use of documents and not so transformative (higher and more complex reflection level) attitudes such as "giving back", which, at the very least, involves other stakeholders, constituting a form of interaction and sharing.

The teachers mentioned taking into account students' feelings and their realities when planning and developing class content and activities. They were

[252]In Brazil, the vast majority of the middle public schools operate in two shifts, one in the morning and another one in the afternoon. For this reason, teachers are in more than one place, what can be pretty challenging due to the long distances and the heavy traffic always existing in large cities.

[253]Refer to table 8 in section 6.3.1.

well aware of how motivation is influential, not to mention determinant, on learning in general. Such awareness seems to inform and drive modifications, besides helping in the decision on whether or not to reuse a specific document (which involves not only the activity *per se*, but also rubrics, instruments, methods, etc.). Examples of this were when R11 said that he/she revised an activity and changed the instruments to teach content to a more rowdy and competitive group; and also when R2 changed the song to be used in a project that connected music and history because the lyrics mentioned the death of a young person and the students had experienced a similar situation in their neighborhood.

In general, we can affirm that teachers relate original and creative didactic work to professionalism. This belief is verified in their documents. Teachers showing a more comprehensive, committed attitude offered us more evidence of transformed/modified resources, modeled and constructed by them, based on their practice, on their students, on their beliefs about teaching, on their worldview as a whole. The ones who seemed less compromised (due to disillusion, lack of interest, lack of time, lack of knowledge, or other reasons) basically related documentation to the organization of their professional work and practicality. Nevertheless, all of them recognized that documentation involves extending memory, and they also agreed that, once installed, the habit of documenting facilitates teachers' work. Few teachers mentioned reasons for not engaging in such a process (documentation); R1 said that she does not like technology a lot and does not know much about computer tools; R8 said that she is not going to develop anything without support from the public administration (she mentioned time and availability of computers), which is the body responsible for quality in education; R10 referred to her disappointment with education… Based on the collected data (from questionnaire and interviews) we strongly suspect that digital technologies influence, encourage and facilitate the genesis and the maintenance of such practice; but we lack evidence to know more about how such influence and encouragement happen. Also, such documents can only be "updated" from a mere condition of an *archive* through teachers' ngaging, curious and responsible attitude.

After such extensive investigation, we tend to agree that documentation is broadly done in one way or another. Based on teachers' answers, pretty much all teachers look for, reuse and repurpose material from the internet at some point

with varying frequency. However, equally clear was the scarce evidence that there is critical, deep, *Model II* type reflection being done and registered. The results from the survey and also from the interviews (with the analysis of corresponding documents) indicate a frequent disconnection between some teachers' theories of action as defined in Sovacool and Hess (2017).

Our investigation used Activity Theory (CHAT) to explain the mediation between teachers and digital technology when developing their documentation work. The mediation determined both instrumentation and instrumentalization processes when transforming artifacts into resources. Because the instrumental (and documental) genesis involves a moment in time, we understood that documentation work represents not only the past and the present, but also the future, as teachers choose what to use and what to reuse, what to look for, what to modify and change. These dynamics rely on a reflective attitude, which, although most of the time is not of a transformational nature, it still is committed to changes, improvements, metacognition, and awareness of the environment and target audience.

On the other hand, we recognize that CHAT and the Extended Mind Theory can only partially explain our results. Not rarely, teachers mentioned how computers and access to digital technology in general fostered their documentation work and their possibilities to search, save, organize, create, and share. There was evidence that the relationship between digital technology and teachers was not only dialectic but also interactive, each one determining and empowering the other. Also, besides the extension and distribution of teachers' cognitive capacities, digital technology demonstrated some agency when limiting or affording some actions and performances. On a simpler note, ultimately computers and digital technology have the "ability" to invite teachers, convince and show them many paths otherwise not thought of. Teachers "want to" reflect and document and for this, they use a resource. More than that, teachers reflect and document "because of" the digital technology that, being present, engaged with such agents.

Lastly, based on our results and partial findings, the last chapter sets out our conclusion and also some suggestions for further research.

7
CONCLUSION

"Change is good."
Rafiki (The Lion King)

Better educational experiences are the ultimate goal of any research done in schools. This dissertation explored teachers' documentation work, how it relates to digital resources and their reflective behavior, in the hope that the findings would help us make robust assumptions about the constitutive role teacher documentation work holds in reflective practice.

Despite our circumscribed field (city of Rio de Janeiro public schools), the use of a selective sample, and the specific, on-time, data collection we reached interesting partial results.

We adopted a theoretical framework based on Activity Theory to ground the teachers' action as they acted and documented their practices (action oriented by goals). The use of the Activity Theory was also directly linked to our interest about how teachers and artifacts relate in order to register and document their practices, and how reflection participates in such documentation work. Based on Rabardel's work (1995, 2001, 2002, 2005) we referred to such interaction as "instrumental genesis", which occurs with the deliberate use of all the existing resources, turned into instruments, towards a specific goal: in our case, the documents originated from the documentation genesis (Gueudet and Trouche, 2012). Teachers interacted with the materiality surrounding their professional environment, applying a scheme to "read" and then transform them into documents. Based on this framework, *motivation* results from the relationship between the subject (the teacher) and the object (the documentation process); in other words, mediation happens as an outcome of the instrumental genesis established whenever the subject recognizes the available artifacts, whether concrete or abstract, as potential and suitable resources for the planned pedagogical activities. This recognition entails accessing the field of self-concept[254] and identifying operational possibilities[255].

[254]This is the conceptual field, as defined by Vergnaud (1993, 2009) of a self. In other words, it is the domain, developed by an individual over an extended period of time through experiences, maturity, and learning situations. Moreira (2009) also cites Vergnaud when he synthesized conceptual field as an informal and heterogeneous set of problems, relations, situations, structures, operations of thinking that are connected to each other, during the acquisition process and afterwards.

Activity theory concepts were also used to explain Shön's reflective practice (Shön, 1983). Human activity presumes deliberate actions that result from interaction with the environment. These actions imply motivation, and motivation is a result of a mental activity directed at a problem solution, what we are defining here as reflection. Therefore, reflections are also a result of human activity mediated by cognitive artifacts.

Digital technology evolves and participates in our daily actions and decisions; and so do digital pedagogical products and resources. Teachers' practices are immersed in this scenario and most likely teachers, the ones with available resources and infrastructure, are (or will be) engaged in digital documentation work somehow.

During our investigation, we listened to and also observed that ICT was used for planning, and for most of the activities realized before the didactic scene. However, such use, when closely investigated under the lens of documentation habits, did not strongly indicate a critical reflective attitude. The teachers almost unanimously mentioned that documentation makes it possible: *to organize, to save time, to retrieve data, to find/remix/share content, to archive, to maintain a memory, to save work samples,* besides *being convenient*. In this regard, documentation work extends and distributes their cognition. Whilst their motivation was assertive, when asked about the usefulness and purpose in terms of improvement, development, and change, the results were diffuse; almost all mentioned that reflection is being done "as they go"; there were no indications of "going back" to rethink after a practice (a unit, a class, a section) is finished. Neither did we find patterns indicating sustained engagement in critical, deep, transformative, and complex reflective practice as defined by Argyris and Schön (1974) and by Sovacool and Hess (2017) respectively. There were no consistent indications of reflection about beliefs or worldview, nor considerations about paradigmatic changes as well. (Sterling, 2010).

The use of ICT in pedagogical practice, as well as the relationship with material resources, seem to be influenced by attendance at in-service ICT courses (continued education). Teachers attending informal or institutional ICT courses

[255]When a subject is in contact with different artifacts, he/she will identify them as resources depending on his/her conceptual field and will look for possible applications, solutions, interactions that relate to the pedagogical situation at hand (see chapter 3 - section 3.3).

(or having vicarious directive help) apparently tend to engage more often and more efficiently with digital technology. They are more motivated and develop better digital literacy than the group not attending such courses.

Based on the theoretical framework used, we conclude that our research question *In which ways does teacher's documentation work relate to reflection?* was only partially answered. Understanding that reflection is a cognitive process, and that documentation is in fact a process under which development is better perceived if investigated over time, our conclusive notes become limited. In addition, we found that CHAT revealed an insufficient theory to better account for and explain the relationship between teachers and digital resources during documental genesis and the development of cognition through a reflective attitude. In fact, there are a few considerations to be made, as follows.

Dialectical vs. interactive mediation

Based on teachers' discourse and content analysis we assert that the mediation that happens during the documentation process is not dialectical but rather interactive. Subject and object intertwine, whilst immersed in a cognitive process. During the instrumentation genesis they both would change and would be changed. Bannell (2019) adds to that mediation the role that our bodies have when we experiment and interact with the world. He asserts that our capacity to develop meaning and build knowledge emerges from our organic interaction with the environment, which is physical, psychophysical and also social (Bannell 2019, p.3). In this regard, Overmann and Malafouris (2017), also assert that cognition is influenced and constituted by things external to the brain, such as the body and the physical world. Teacher's deliberation is not the sole agent in the process but there are external, structural, physical and psychological determinant constraints as well. Our data suggested such interactions mentioned by Bannell (2019) but they were insufficient to determine patterns and correlations. In fact, questions such as "how do social environment and social relations stimulate, determine and explain the existence and development of teachers' documental work?", "how do physical constraints promote or limit the documentation practice?", and "how does the documentation process constitute a physical, psychophysical and social experience?" were unable to be explored and answered due to the theoretical framework chosen and the way the data was analyzed.

Sociomaterialism – a possibility

Besides the awareness that bodies, perceptions, feelings, external environment and intentions are constitutive of cognitive processes and present constraints that could both limit or promote cognition, we also understood that, based on our analysis, digital technology has an agency, and active participation in our object of study: teacher's digital documentation work as an expression of a reflective attitude. For that reason, further studies should rely on a different and more comprehensive theoretical framework that could better explain the existing dynamics during such process. For the last couple of decades, Material Engagement Theory (MET) has been offering a theoretical background to investigations about material agency on cognitive processes. Based on this perspective we are not limited to the interaction between body, emotions, environment and cognition, but the focus is on the relationship as part of which cognition is constituted.

It is worth pointing out that MET is grounded on CHAT but goes beyond it. Aligned with that vision, the MET is concerned with the impact of material culture (concrete embodiments of social-cultural practices) on the development of human cognition; cognition is a form of material engagement, understood as "the distinctively human ability to think through, with, and about the material world" (Malafouris, 2013, p. 33-34). Considering cognition as a kind of activity, it involves interaction, and MET tentatively tries to figure out the causal efficacy of materiality in the enactment and constitution of this cognition (Malafouris, 2013, p.8). According to Malafouris (2013, p.18) interpretation, intentionality, and forms of representation are not properties of things, and they are not properties of humans either, rather they are the properties of material engagement, the human predisposition to reconfigure their bodies and extend their senses by using tools and material culture (p. 20). His view would more likely fit to better explain a documentation process. In fact, the agency of digital technology is manifested when teachers are *invited* to perform new practices, to *explore* new content and to *organize*, *communicate* and *share* their work. Materials take part in interactions in

educational practice; they change what is involved in this practice and produce effects (Sorensen, 2009).

The consideration of MET would assist our conclusion that digital technology has a key participatory role during such documentation, an agency: digital resources are well suited for registration, modifications, creation, search, and documentation *per se*. The content of the interviews suggested teachers' disposition towards using computers and mobile phones, whether connected (or not) to the web, to prepare their *pedagogical scene*[256]. They said that they retrieved, downloaded, saved, remixed, recorded, and also developed original pieces. While engaged in these activities, teachers are in a continuous relationship with resources; creating and modifying as they think, perceive, question and change. We could borrow Barad's (2007) definition of pedagogical documentation, used in Lenz-Taguchi's (2009) work about early childhood, to reinforce that pedagogical documentation is a "material reconfiguration of discursive practices"; when documenting, teachers create files, folders, and content that relate to their practices. In this sense, when participating in the documentation process, digital technology is a "doing" and not a "thing" (Barad, 2007, p.183). **A document is then a "place" where the materiality of a teacher's work is entangled with his/her views and beliefs about his/her documentation and about his/her practices** (Barad, 2007).

Interaction and materiality – an ever changing process

During our analysis and discussion, we showed that interaction and materiality were also manifested by me, my discourse when presenting the study, and my participation when conducting the interviews and the focus group, and the participants. Actually, there was an intra-action not only involving material resources, but in this case between the researcher and the teacher being interviewed. The teachers were exposed to information and heard comparable testimonies. As an illustration of such change, R3 shared the following about his documental genesis[257]:

[256]Margolinas and Rivière, 2005.

[257]In Portuguese: " ...a sua participação no ano passado, contribui bastante para isso né? Você foi lá e entrevistou a gente e tal, tal, tal..... eu nunca tinha parado para pensar nisso, realmente... Cara, eu faço tanta coisa com os alunos aqui… cara! tanta coisa diferente, cara, eu não documento nada,

> "... your participation last year contributed a lot to this right? You went there, interviewed us, and so… I had never thought about that before, really… Dude, I do so many things with students here, dude, so many different thing and I don't document anything, I do not make a record of anything… ah, why? Why? (...) why don't I make a record and share this material?"

As our investigation did not extend over time, thereby allowing for continuous observations for the study of cognitive processes and changes inherent to engagement and interaction, we cannot affirm, but yet we can suspect, that favorable conditions together with information about pedagogical documentation could favor and encourage such practice. This belief points to the need for more extensive research, with ongoing observations and interactions in order to gather evidence about how such interactions and materiality would influence teachers' documentation genesis.

External constraints

Further investigations could certainly be done on the external, psychological, and physical constraints that may prevent teachers from documenting more regularly and efficiently. Some of the reasons, based on our specific milieu (city of Rio de Janeiro public schools), undoubtedly include lack of time, lack of infrastructure (available and working school computers and internet, for example), lack of motivation/recognition, and also the existing reinforced curriculum that does not allow much space for original work and differentiation (Lelis, 2012; Tardiff, 2013). These constraints most likely contribute to the disconnection between teachers' espoused theory and their theory-in-use. Future research should take into account such constraints, as well as teachers' beliefs, when they intentionally and voluntarily engage in documenting their work.

Teachers' documentation outside school

What is more, all issues and challenges in education involve teacher training. Such courses are committed to the development of the specific

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eu não registro nada... ah, porque? Porque? ... (...) porque é que eu não registro e não divulgo esse material?"

"knowledge" pre-service teachers should learn, evolve, and build minimally in order to teach efficiently. Documentation work could help unveil aspects of such "knowledge", at the very least *pedagogical content knowledge*[258], the one situated and pretty much (if so) individually documented (Cruz, 2017; Roldão, 2017; Shulman, 1986, 1987; Tardiff, 2000). It is therefore the task of future studies to carry out more detailed and careful research about documents and resources capable of demonstrating a more critical, consistent and systematic reflective attitude as well as the supporting "practice-specific" schemes of use, thereby revealing what teachers intend and what they actually do, as well as their proactivity towards quality. We believe that teachers' documentation work (documental genesis), when based on critical[259] reflection and available digitally, constitutes a powerful instrument, characteristic of effective pedagogical practices, which are sharable and able to transform educational paradigms.

Despite our partial results and some inconclusive data, we claim that our evidence indicates that, besides developing critical reasoning, documentation work improves analytical ability, promotes creativity and the capacity to establish relations; it generates data, is future-oriented, and also contributes to the search and discovery of new perspectives. Also, despite the lack of more consistent research material to relate documentation work to deep critical reflective practice, we can argue that documentation work constitutes an epistemological instrument and, in this regard, it results from an enactment and it fosters metacognition and also a minimal deliberate and intentional analysis when being generated. Besides, based on the documents observed and teachers' discourse, the work helps to elucidate, even as a "messy patchwork", what is really done in class, the enacted curriculum. Further studies based on a more extensive theoretical framework are necessary to better elucidate a) in which ways and to what extent teacher's documentation work relates to reflection, b) how material engagement participates and defines documentation genesis, and c) potentialities and uses of teachers' documentation work, inside and outside schools.

[258] Shulman (1986).

[259] For more on critical reflection refer to section 3.2.1.

8
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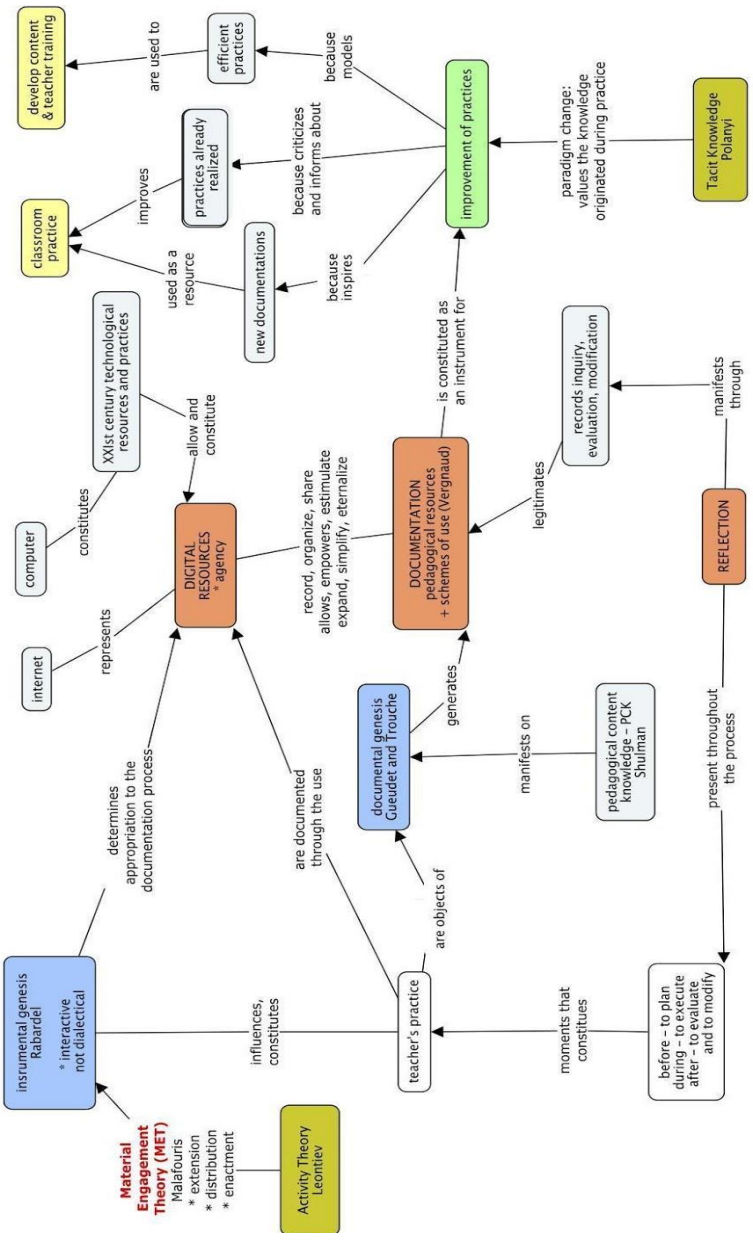
9
APPENDIX

Appendix I: Conceptual Map



Appendix II: Review of Literature - review since 2008

Database[1]	Period	Key words (Portuguese : English)	Total related documents	Relevant documents
1) Pesquisa integrada PUC/RJ	2007 2019	documentação digital : (digital documentation)	24	2
	2007 2019	documentação + reflexão + docente : (documentation + reflection + teaching)	59	6[2]
	2007 2018	portfolio digital : (digital portfolio)	12	4
2) Repositório-dissertações UFSCar	2007 2019	documentação + digital : (documentation + digital)	147	2
	2007 2019	portfolio digital : (digital portfolio)	42	1
3) Biblioteca digital USP	2008 2019	documentação : (documentation)	124	5[3]
	2008 2019	portfolio digital + educação*** : (digital portfolio + education)	2	1
4) Scielo	2007 2019	documentação digital : (digital documentation)	3	1
	2007 2019	documentação + professor+ reflexão : (documentation + teacher+ reflection)	1	0
	Aberto (open)	portfolio digital : (digital portfolio)	3	1
5) Google Acadêmico	2007 2019	documentação digital + reflexão + docente + educação : (digital documentation + reflection + teaching + education - odontologia - medicina - patrimônio : – odontology – medical school – heritage)	11	0
	2007 2019	educação + documentação + gênese documental + reflexão : (education + documentation + documental genesis + reflection + prática – medicina – odontologia – arquivística – biblioteca : + practice - medical school – odontology – archival – library – creche - - patrimônio : - nursery school - heritage)	20	1
	2007 2019	portfolio digital : (digital portfolio)	12	0
6) Banco de teses CAPES	2008 2019	documentação digital : (digital documentation)	6	0
	2008 2019	portfolio digital : (digital portfolio)	34	0
7) Portal de periódicos CAPES	2009 2019	documentação + digital : (digital documentation)	5	1
	2009 2019	portfolio digital : (digital portfolio)	4	0

[1] Web addresses: 1) http://www.dbd.puc-rio.br/sitenovo/; 2) https://repositorio.ufscar.br/; 3) http://www.sibi.usp.br/bibliotecas/digitais-sistemicas/portal-busca-integrada/; 4) https://search.scielo.org/; 5) https://scholar.google.com/; 6) https://catalogodeteses.capes.gov.br/catalogo-teses/#!/; 7) https://www-periodicos-capes-gov-br.ez370.periodicos.capes.gov.br/

[2] Four of them about nursing, pre-K, and lower school

[3] All of them about nursing, pre-K, and lower school

Appendix III: Secondary bibliography based on the literature review

1. Portal "PUC Integrada"- Pontifícia Universidade Católica/RJ - Brazil
1.1) *"documentação digital"*

MARQUEZ, M. J. (2009). La integración del tema transversal en la enseñanza de la documentación para traductores. In: Mutatis Mutandis; Vol. 2, Núm. 2 Pedagogía y Didáctica de la traducción II; 346 - 366 ; 2011-799X; Colombia.

PEREIRA, E., RUBIO, T. M., BARBOSA, C., A., P. (2013) Documentação digital da arte rupestre: apresentação e avaliação do método em dois sítios de Monte Alegre, Amazônia, Brasil. In: *Boletim do Museu Paraense Emílio Goeldi*. Ciências Humanas. 8(3):585-603; MCTI/Museu Paraense Emílio Goeldi.

1.2) "*documentação" + "reflexão" + "docente"*

GONTIJO, F. L. (2011) Documentação pedagógica como instrumento de reflexão e produção docente na educação infantil. In: Paidéia, Ano 8 n.10 pp. 119-134. Available at: http://www.fumec.br/revistas/index.php/paideia/article/viewFile/1303/884. Last accessed on May 15th, 2019.

MATOS, F. G. (2018) Professores e Formadores em Mudança. Relato de um processo de reflexão e transformação da prática docente. In: DELTA: Documentação e Estudos em Linguística Teórica e Aplicada; v. 19, n. 1

MENDONÇA, C. N. (2009) A documentação pedagógica como processo de investigação e reflexão na educação infantil. Universidade Estadual Paulista (UNESP)

ROSA, C. S. R. S (2014). Pedagogia Freinet: a construção de uma práxis em turmas de 5ª a 8ª séries. Universidade Federal do Rio Grande do Norte, BR, UFRN, Programa de Pós-Graduação em Educação.

SEREDIUK, E. F.; FERNANDES, R. S. (2014) Os registros dos professores: Memórias e reflexões sobre a prática educacional na primeira infância. In: Revista Eletrônica de Educação, Vol 8, n. 3, pp 68-85. Universidade Federal de São Carlos. São Paulo.

VIEIRA, F. R. (2013). A formação de professoras em uma creche universitária: o papel da documentação no processo formativo. Universidade de São Paulo - USP.

1.3) "*portfolio digital"*

BONA, A. S. D.; BASSO, M. V. de A. (2013) Portfólio de Matemática: um instrumento de análise do processo de aprendizagem. In *Bolema: Boletim de Educação Matemática*, [s. l.], n. 46, p. 399. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=edssc

i&AN=edssci.S0103.636X2013000300005&lang=pt-br&site=eds-live&scope=site>. Last access on May 17th, 2019.

MACHADO, M. F. R. C.; SILVA, F. H.; and SAKALAUSKAS, S. R. (2018) As Contribuições Do Portfólio Digital Como Instrumento De Avaliação. In

Intersaberes, [s. l.], v. 13, n. 30, p. 494–503, 2018. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=135551423&lang=pt-br&site=eds-live&scope=site>. Last access on May 17th, 2019.

PALMA, R. C. D. (2010) A produção de sentidos sobre o aprender e ensinar matemática na formação inicial de professores para a educação infantil e anos iniciais do ensino fundamental. [s. l.]. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=edsbas&AN=edsbas.6E4DB506&lang=pt-br&site=eds-live&scope=site>. Last access on May 17th, 2019.

RAUSCH, R. B.; and SADALLA, A. M. F. A. (2008) Promoção de reflexividade na formação inicial docente: o papel do professor orientador de pesquisa. *ETD: Educação Temática Digital*, [s. l.], n. 2, p. 189. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=edsdoj&AN=edsdoj.8ccae7c37f92444cba00ea5e535c05d0&lang=pt-br&site=eds-live&scope=site>. Last access on May 17th, 2019.

2. Portal "UFSCar" - São Carlos University/SP - Brazil

2.1) *"documentação"*

ABREU, M. G. S. (2008) Uma investigação sobre a prática pedagógica: refletindo sobre a investigação nas aulas de matemática. Tese de Mestrado. Universidade Federal de São Carlos. São Paulo.

SANTOS, C. A. S. (2017) Modelo de Gestão do Conhecimento para Organizações de Educação Profissional e Tecnológica : a comunidade de prática na implementação de um repositório digital institucional. Tese de Doutorado. Universidade Federal de São Carlos. São Paulo.

2.2) *"portfolio digital"*

MARTINS, K. P. G. (2016) Usos de portfólios em diferentes práticas : um olhar de uma educadora. São Carlos: UFSCar.. 111 p. Dissertation (Masters degree) -- Universidade Federal de São Carlos.

3. Portal "USP" - São Paulo University/SP - Brazil

3.1) *"documentação"*

BARACHO, N. V. P. (2012) A documentação na abordagem de Reggio Emilia para a educação infantil e suas contribuições para as práticas pedagógicas: um olhar e as possibilidades em um contexto brasileiro. Dissertation (Master in Education). Universidade de São Paulo - USP. São Paulo, 2012. Available at: http://www.teses.usp.br/teses/disponiveis/48/48134/tde-26032012-161504/pt-br.php. Last access on May 15th, 2019.

MARQUES, A. C. T. L. (2011) A construção de práticas de registro e documentação no cotidiano do trabalho pedagógico da educação infantil. Dissertation (PhD in Education) - Universidade de São Paulo - USP. São Paulo. Available at: http://www.teses.usp.br/teses/disponiveis/48/48134/tde-07042011-141501/pt-br.php. Last access on May 16th, 2019.

MARQUES, A. C. T. L. and ALMEIDA, M. I. (2011). A documentação pedagógica na Educação Infantil: traçando caminhos, construindo possibilidades. In *Revista de Educação Pública*. Cuiabá, v. 20, n. 44, pp. 413-428. Available at: http://periodicoscientificos.ufmt.br/ojs/index.php/educacaopublica/article/viewFile/315/283. Last access on May 15th, 2019.

_____ (2012). A documentação pedagógica na abordagem italiana: apontamentos a partir de pesquisa bibliográfica. In *Revista Diálogo Educacional*, [S.l.], v. 12, n. 36, p. 441-458. Available at: < https://periodicos.pucpr.br/index.php/ dialogoeducacional/article/view/4639>. Last access on May 16th, 2019.

VIEIRA, F. R. (2013). A formação de professoras em uma creche universitária: o papel da documentação no processo formativo. Universidade de São Paulo - USP. Dissertation (Master in Education) Available at: http://www.teses.usp.br/teses/disponiveis/48/48134/tde-24062013-162706/pt-br.php. Last access on May 16th, 2019.

3.2) *"portfolio digital" + "educação"*

ANDRADE FILHO, A. C. (2011) *O uso do portfólio na formação contínua do professor reflexivo pesquisador*. 2011. Dissertation (PhD in Education) - São Paulo University/USP, São Paulo.

4. Portal "SciELO"

4.1) *"documentação digital"*

HORN, C.I., and FABRIS, E. H. (2017). Registro docente contemporâneo: infância e docência em tempos digitais. In *Educação e realidade*, Porto Alegre, v. 42, n. 3, pp. 1103-1122. Available at: <http://www.scielo.br/scielo.php?script=sci_ arttext&pid=S2175-62362017000301103&lng=en&nrm=iso>. Last access on May 16th, 2019

4.2) *"documentação" + "professor" + "reflexão" :* None
4.3) *"portfólio digital"*

BONA, A. S; and BASSO, M. V. A. (2013) Portfólio de Matemática: um instrumento de análise do processo de aprendizagem. In Bolema vol.27 no.46, Rio Claro, São Paulo, Brazil.

5. Portal "Google Acadêmico"

5.1) *"documentação" + "educação" + "gênese documental" + "reflexão" - "medicina" - "odontologia" - "arquivística" - "creche" - "biblioteca" - "patrimônio" :* None
5.2) *"documentação" + "educação" + "gênese documental" + "reflexão" - "medicina" - "odontologia" - "arquivística" - "creche" - "biblioteca" - "patrimônio"*

TEIXEIRA, P. C. and MATOS, J. M. (2017) A Teoria da Atividade: conceitos e aplicações na formação contínua de professores, In *REMATEC* Ano 12, n. 26, p.

6-22. Portugal.

5.3) *“portfólio digital”:* None

6. Portal CAPES for dissertations

6.1) *“documentação digital”:* None

6.2) *“portfólio digital”:* None

7. Portal CAPES for journals

7.1) “documentação” + ”digital”

HORN, C.I., and FABRIS, E. H. (2017). Registro docente contemporâneo: infância e docência em tempos digitais. In Educação e realidade, Porto Alegre, v. 42, n. 3, pp. 1103-1122. Available at: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S2175-62362017000301103&lng=en&nrm=iso>. Last access on May 16th, 2019

7.2) “portfólio digital”: None

Appendix IV: CRE's information

Educational departments for the 11 districts of the municipality of Rio de Janeiro.

CRE	address/phone (city code +21)	Covered Districts
1a.	Rua Edgard Gordilho, nº 63 Praça Mauá 2263-0108/2253-5108	Mangueira. Cidade Nova. São Cristóvão. Catumbi. Gamboa. Praça Mauá. Santa Teresa. Caju. Paquetá. Santo Cristo. Santa Teresa (Morro dos Prazeres). São Cristóvão (Morro do Tuiuti). Estácio. Mangueira (Morro dos Telégrafos). Saúde. Centro. Praça Onze. Rio Comprido (Morro do Turano). Benfica. Rio Comprido. Vasco da Gama. Bairro de Fátima. Praça da Bandeira.
2a.	Pça. General Álcio Souto s/nº - Lagoa 2537-0277/2535-7190 2535-6225/2535-0629	Alto Boa Vista. Andaraí. Jamelão. Tijuca. Rio Comprido. Grajaú. Gávea. Leblon. Lagoa. Vila Isabel. Flamengo. Copacabana (Morro dos Cabritos). Catete. Usina. Jardim Botânico. Maracanã. Vidigal. Copacabana. Urca. São Conrado. Praia Vermelha. Humaitá. Ipanema. Botafogo. Cosme Velho. Tijuca (Comunidade da Chacrinha). Laranjeiras. Rocinha. Glória. Leme. Grajaú (Morro Nova Divinéia).
3a.	Rua 24 de Maio 931 Fundos Engenho Novo 3278-3713/3278-3587	Inhaúma. Bonsucesso. Jacaré. Engenho de Dentro. Engenho Novo. Cachambi. Jacarezinho. Todos os Santos. Maria Da Graça. Pilares. Complexo do Alemão - Ramos. Manguinhos. Piedade. Ramos. Rocha. Sampaio. Engenho Da Rainha. Abolição. Del Castilho. Água Santa. Higienópolis. Largo do Jacaré. Lins de Vasconcelos. Encantado. Méier. Tomás Coelho. Riachuelo. Benfica. Cascadura.
4a.	Rua Professor Luís Rondelli 150 - Olaria 3393-3476/3975-5956	Praça Do Carmo/Penha. Guarabu. Manguinhos. Cordovil. Penha Circular. Bonsucesso. Vigário Geral. Ramos. Brás de Pina. Olaria. Vila do João / Maré. Parada de Lucas. Jardim América. Vila Da Penha. Pavuna.
5a.	Rua Marupiara - Rocha Miranda 3372-0870/3372-0201	Marechal Hermes. Rocha Miranda. Madureira. Vila Kosmos. Cascadura. Irajá. Vila Da Penha. Campinho. Colégio. Osvaldo Cruz. Cavalcante. Vicente de Carvalho. Vaz Lobo. Vista Alegre. Bento Ribeiro. Honório Gurgel. Quintino Bocaiúva. Turiaçu. Guadalupe.Tomás Coelho. Coelho Neto. Vigário Geral.
6a.	Rua dos Abacates s/nº - Deodoro 2457-0017/3017-6989	Costa Barros. Deodoro. Conj. Hab. Amarelinho - Irajá. Acari. Parque Anchieta. Guadalupe. Ricardo de Albuquerque. Jardim Cristina Capri - Anchieta. Barros Filho. Caminho do Job - Pavuna. Coelho Neto. Irajá. Cascadura. Parque Colúmbia. Colégio.
7a.	Av. Ayrton Senna 2001 Barra da Tijuca 3325-9470/3325-3228	Barra da Tijuca. Camorim. Vargem Grande. Jacarepaguá - Taquara. Tanque. Gardênia Azul. Pechincha. Recreio dos Bandeirantes. Curicica. Itanhangá. Rio Das Pedras. Vargem Pequena. Anil. Cidade De Deus. Praça Seca. Freguesia. Vila Valqueire.
8a.	Rua Biarritz 31 - Bangu 3332-1948/3332-1917	Vila Militar. Senador Camará. Deodoro. Santíssimo. Magalhães Bastos. Realengo. Sulacap. Padre Miguel. Jabour. Guadalupe. G. Da Silveira. Jardim Sulacap. Bangu. Vila Kennedy. Marechal Hermes. Deodoro. Lote São José. Campo dos Afonsos.
9a.	Rua Amaral Costa 140 Campo Grande 3394-1389/3394-1433	Guaratiba. Paciência. Cachamorra. Araújo de Cosmos. Nova Iguaçu. Santíssimo. Cosmos. Campo Grande. Senador Vasconcelos. Campinho. Inhoaíba.
10a.	Av. Padre Guilherme Decaminada 71 - Santa Cruz 3395-1495/3395-8949	Palmares . Jardim Maravilha Campo Grande. Barra De Guaratiba. Paciência. Jardim dos Vieiras. Cosmos. Santa Cruz. S. Fernando. Guaratiba. Ilha de Guaratiba. Sepetiba. Pedra de Guaratiba.
11a.	Estrada dos Maracajás, nº 1294 - Galeão - Ilha do Governador 2465-1513/3975-2540	Portuguesa. Zumbi. Cacuia. Pitangueiras. Praia da Bandeira. Moneró. Tauá. Freguesia (Ilha do Governador). Galeão. Bancários. Jardim Guanabara. Tubiacanga. Ilha do Governador. Jardim Carioca, Itacolomi. Cidade Universitária. Cocotá.

Appendix V: Consent form – Portuguese

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título da Pesquisa: A documentação digital como instrumento de reflexão na prática docente.

Eu Paula Lüderitz de Albuquerque Lenz-Cesar, doutoranda do Departamento de Educação da PUC-Rio[1] responsável pela pesquisa acima referida, estou fazendo um convite para você participar como voluntário(a) deste meu estudo. As informações contidas nesta folha têm por objetivo firmar acordo escrito, autorizando sua participação com pleno conhecimento da natureza dos procedimentos a que você será submetido(a).

I – Justificativa, objetivos e procedimentos que serão utilizados na pesquisa
Pensar em educação no Brasil significa pensar formação e práticas docentes, didática e currículo, e fundamentalmente compreender a realidade situada de onde esta educação acontece. Este estudo integra a área de investigação das práticas docentes, mais especificamente o trabalho documental do professor: a documentação pedagógica aparece como um elemento principal que possibilita a autoria do professor e uma prática de reflexão.

A motivação do estudo se baseia nas crenças de que o professor crítico e reflexivo é indicador de um profissional comprometido eticamente e pedagogicamente com o ensino e a aprendizagem, de que o trabalho de documentação ajuda a desenvolver práticas reflexivas, e de que o uso de tecnologias digitais favorece e potencializa a documentação.

Esta pesquisa tem como finalidade a análise de documentos digitais de um grupo de professores do ensino fundamental II da cidade do Rio de Janeiro na tentativa de achar raízes e potencialidades para a prática reflexiva do professor.

Para a coleta de dados será utilizada uma abordagem qualitativa utilizando os seguintes instrumentos metodológicos. O estudo será realizado por mim, sob a orientação da Professora Magda Pischetola.

II – Métodos de pesquisa:
● Entrevista individual
● Análise documental (registros disponibilizados voluntariamente pelo professor no momento das entrevistas)
● Grupo focal

III – Envolvimento na pesquisa, garantia de assistência e esclarecimentos
Você tem liberdade de se recusar a participar ou retirar seu consentimento, em qualquer fase da pesquisa, sem penalização alguma e sem prejuízo ao seu cuidado. Sempre que quiser poderá pedir mais informações sobre a pesquisa através do meu email: paulaluderitz@gmail.com, ou o da minha orientadora, Professora Magda Pischetola (magda@puc-rio.br). Em caso de algum problema relacionado com a pesquisa você terá direito à assistência gratuita que será prestada por mim e pela minha orientadora, bastando para isso entrar em contato através dos veículos citados acima.

IV – Desconfortos, riscos possíveis e benefícios esperados
A participação nesta pesquisa não traz complicações legais. Os procedimentos adotados obedecem aos Critérios da Ética em Pesquisa com Seres Humanos conforme Resolução no. 196/96 do Conselho Nacional de Saúde. Nenhum dos procedimentos usados oferece riscos à sua dignidade. Ao participar desta pesquisa você não terá nenhum benefício direto. Entretanto, esperamos que este estudo contribua com informações importantes sobre como a documentação digital docente pode ser entendida como um instrumento de reflexão das práticas do professor. O estudo acrescenta também elementos importantes à literatura, onde o pesquisador se compromete a divulgar os resultados obtidos.

V – Confidencialidade

As informações coletadas nesta pesquisa serão estritamente confidenciais, e serão divulgadas apenas em eventos ou publicações científicas, não havendo identificação dos voluntários, a não ser entre os responsáveis pelo estudo, sendo assegurado o sigilo sobre sua participação. Uma cópia deste consentimento informado será arquivada e outra será fornecida a você.

VI – Custos da participação

A participação no estudo não acarretará custos para o participante e não será disponível nenhuma compensação financeira adicional.

Autorização

Após estes esclarecimentos, solicitamos o seu consentimento de forma livre para permitir sua participação nesta pesquisa. Portanto, preencha os itens que seguem:

Eu, _____após a leitura e compreensão destas informações, entendo que minha participação é voluntária, e que eu posso sair a qualquer momento do estudo, sem prejuízo algum. Declaro que recebi cópia deste termo de consentimento, e autorizo a realização da pesquisa e a divulgação dos dados obtidos neste estudo.

Rio de Janeiro,____/____/_____

Nome do Voluntário:_____

Assinatura do Voluntário:_____

Telefone(s) para contato:_____

Assinatura da pesquisadora, doutoranda Paula Luderitz de Albuquerque Lenz-Cesar:

_____

(021) 998771415 - email: paulaluderitz@gmail.com

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[1] Departamento de Educação: Rua Marquês de São Vicente, 225 - Prédio Cardeal Leme - 10º andar - sala 1049

Appendix VI: Consent Form – English

PONTIFÍCIA UNIVERSIDADE CATÓLICA DO RIO DE JANEIRO

PARTICIPANT CONSENT FORM

Title of the study: Digital documentation promoting reflexive practice

I, Paula Lüderitz de Albuquerque Lenz-Cesar, PhD student from the Department of Education at PUC-Rio[1], responsible for the study referred above, am inviting you to participate as a volunteer. All the information described here are to firm an agreement, authorizing your participation with your full understanding about its nature.

I – Rationale, objectives and procedures that will be used on the study

Think about education in Brazil means think about teacher training and pedagogical practices, didactic and curriculum, and mainly in comprehend the situated reality where this education is taking place. This study integrates the field of pedagogical practices investigation, more specifically teacher documentation process. The pedagogical documentation appears as a key element that allows authorship and reflective practice.

The motivation s based on the belief that a critical and reflective teacher is an indicator of a professional ethically and pedagogically committed with the teaching and learning process, that the documentation work helps to develop critical practices, and also that the use of digital technologies favors and enhances the documentation.

This study's goal is to investigate digital documentation from a group of public middle school teachers from the City of Rio de Janeiro with the objective of finding pieces of evidence of a reflective practice.

To collect data we will use a qualitative method, using the following instruments. The study will be realized by me with the orientation o professor Magda Pischetola

II – Research methods:

- Individual interview
- Documental analysis (voluntarily presented by the teachers during the interviews)
- Focal group

III - Involvement, assistance and clarifications

You have the freedom to refuse to participate or to revoke your consent, without any liability or penalty. You can always ask for further information about this study contacting me through my email address: paulaluderitz@gmail.com. You can also contact my supervisor, Professor Magda Pischetola on email at magda@puc-rio.br. if you have any trouble due to this research you will be granted free assistance from me and from my supervisor through a contact using the email addresses above.

IV – Discomfort, possible risks and expected benefits

The participation on this study does not bring any legal liability. The adopted procedures follow the Ethical criteria for research with human being according to the resolution number 196/96 from the health national council. None of the procedures used offers any risk to your dignity. Also, by participating on this study you will not have any direct benefit. We do expect that this study contributes with important information about how the teacher digital documentation can be related to reflective practices. This study also adds relevant elements to the field literature, as the researcher will communicate the results.

V – Confidentiality

All the information collect is strictly confidential, and will be released only on academic events or publications. Besides for research member only, your personal identification is guaranteed. A copy of this consent will be filed and another one will be given to you.

VI – Participation costs

There is no cost to participate on this research, and there is no additional financial reimbursements.

Authorization

After the explanations, we request your voluntary consent to allow your participation on this research. Please fill the information below:

I, _____ after reading and compehending this information, understand that my participation is voluntary, and that i can quit at any moment, without any liability. I declare that i received a copy of this consent form, and i authorize this study and the disclosure of the collected data.

Rio de Janeiro,____/____/____

Volunteer name:_____

Volunteer signature:_____

Phone:_____

Signature of the PhD student researcher Paula Luderitz de Albuquerque Lenz Cesar

_____

(021) 998771415 - email: paulaluderitz@gmail.com

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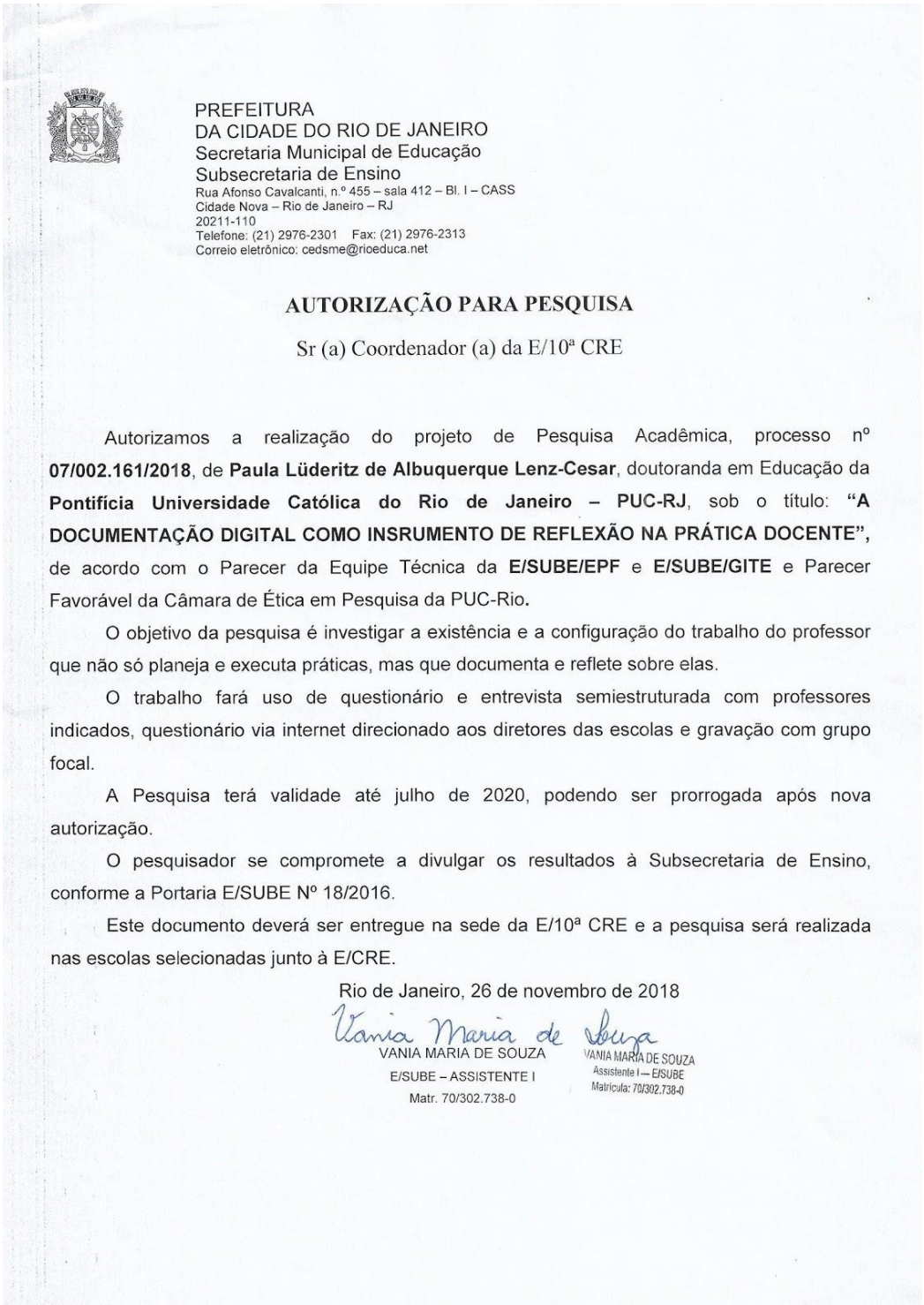
[1] Departamento de Educação: Rua Marquês de São Vicente, 225 - Prédio Cardeal Leme - 10º andar - sala 1049

Appendix VII: Sample of an authorization to visit the educational districts from the City Hall Department of Education (SME)



PREFEITURA
DA CIDADE DO RIO DE JANEIRO
Secretaria Municipal de Educação
Subsecretaria de Ensino
Rua Afonso Cavalcanti, n.º 455 – sala 412 – Bl. I – CASS
Cidade Nova – Rio de Janeiro – RJ
20211-110
Telefone: (21) 2976-2301 Fax: (21) 2976-2313
Correio eletrônico: cedsme@rioeduca.net

AUTORIZAÇÃO PARA PESQUISA

Sr (a) Coordenador (a) da E/10ª CRE

Autorizamos a realização do projeto de Pesquisa Acadêmica, processo nº **07/002.161/2018**, de **Paula Lüderitz de Albuquerque Lenz-Cesar**, doutoranda em Educação da **Pontifícia Universidade Católica do Rio de Janeiro – PUC-RJ**, sob o título: **"A DOCUMENTAÇÃO DIGITAL COMO INSRUMENTO DE REFLEXÃO NA PRÁTICA DOCENTE",** de acordo com o Parecer da Equipe Técnica da **E/SUBE/EPF** e **E/SUBE/GITE** e Parecer Favorável da Câmara de Ética em Pesquisa da PUC-Rio.

O objetivo da pesquisa é investigar a existência e a configuração do trabalho do professor que não só planeja e executa práticas, mas que documenta e reflete sobre elas.

O trabalho fará uso de questionário e entrevista semiestruturada com professores indicados, questionário via internet direcionado aos diretores das escolas e gravação com grupo focal.

A Pesquisa terá validade até julho de 2020, podendo ser prorrogada após nova autorização.

O pesquisador se compromete a divulgar os resultados à Subsecretaria de Ensino, conforme a Portaria E/SUBE Nº 18/2016.

Este documento deverá ser entregue na sede da E/10ª CRE e a pesquisa será realizada nas escolas selecionadas junto à E/CRE.

Rio de Janeiro, 26 de novembro de 2018

Vania Maria de Souza

VANIA MARIA DE SOUZA
E/SUBE – ASSISTENTE I
Matr. 70/302.738-0

VANIA MARIA DE SOUZA
Assistente I – E/SUBE
Matrícula: 70/302.738-0

Appendix VIII: Sample of authorization by a district education department (10th CRE)

PREFEITURA DA CIDADE DO RIO DE JANEIRO
Secretaria Municipal de Educação
10ª Coordenadoria Regional de Educação
Gerência de Educação

AUTORIZAÇÃO PARA PESQUISA

Sr. Diretor

Autorizamos a realização de Pesquisa Acadêmica nas Unidades Escolares Do 6º ao 9º ano, intitulada **"A DOCUMENTAÇÃO DIGITAL COMO INSTRUMENTO DE REFLEXÃO NA PRÁTICA DOCENTE".**

O objetivo da pesquisa é investigar a existência e a configuração do trabalho do professor que não só planeja e executa práticas, mas que documenta e reflete sobre elas.

A pesquisa fará uso de questionário /entrevista.

O pesquisador se compromete a respeitar a rotina da Unidade e a divulgar o resultado à Gerência de Educação da E/10ªCRE, conforme Portaria E/SUBE Nº 1/2018.

Pesquisador:

- PAULA LÜDERITZ DE ALBUQUERQUE LENZ-CESAR
  RG: 087039756

Rio de Janeiro, 06 de novembro de 2018.

Luís Carlos Nunes
Assistente II
E/10ª CRE/GED
Mat. 12/120.222-5

Av. Padre Guilherme Decaminada – 71 - Santa Cruz - Rio de Janeiro – RJ – CEP - 23575-000
Telefones: (21) 31581905 - (21) 31582034 - Correio Eletrônico – gedcre010@rioeduca.net

CRE1	CRE 2	CRE 3	CRE 4	CRE 5	CRE 6	CRE 7	CRE 8	CRE 9	CRE 10	CRE 11
CIEP Henfil	CIEP Nação Rubro Negra	EM Francisco Jobim	CIEP Gregório Bezerra	EM Aspirante Carlos Alfredo	CIEP Anton Makarenko	CIEP Carlos Drumond de Andrade	CIEP Antonio Evaristo de Moraes	CIEP Herivelto Martins	EM Haydea Vianna	EM. Brigadeiro Eduardo Gomes
EM Marechal Trompowsky	CIEP presidente agostinho neto	EM Gustavo Ambrust	EM Odilon de Andrade	EM Irã	CIEP Glauber Rocha	CIEP Lauro de Oliveira Lima	CIEP Gilberto Freire	EM Ministro Alcides Carneiro	CIEP 1o. de maio	EM Jornalista Orlando Danta
EM Tia Ciata	EM Camilo Castelo Branco	EM Rep. de El Salvador	EM Suiça	EM Leonor Posada	CIEP Oswald de Andrade	EM Juan Montalvo	EM Antonio Bandeira	EM Professor Antonio Boaventura	CIEP Ismael Nery	EM Anita Garibaldi
EM Calouste Gulbenkian	EM afranio peixoto	EM Brigadeiro Faria Lima	EM Eneyda Rabello	EM Paraguai	EM Charles Anderson Weaver	EM Octavio Frias de Oliveira	EM Astrogildo Pereira	EM Mayra Aguiar da Silva	EM Ginasio Prof. Jorge Luiz I. Almeida	EM. Conjunto Praia da Bandeira
EM General Mitre	EM Albert Schweitzer	EM maranhão	EM Joracy Camargo	EM Claudio Ignacio de Oliveira	EM Jornalista e Escritor Daniel Piza	EM Rio das Pedras	EM Clementino Fraga	EM prof. Floriano de Brito	EM Manoel Porto Filho	GEC Anísio Teixeira
EM Portugal	EM Clotilde Guimarães	EM Prof. Afonso Várzea	EM andrade neves	EM Newton Braga de Faria	EM Monte Castelo	EM Gastão Monteiro	EM Coronel Corsino do Amarante	EM Rubens de Farias Neves	EM Ronald de Carvalho	EM Belmiro Medeiros
GEC Juan Antonio Samaranch	EM Deodoro	EM José Aparecido do Prado Sarti	EM Brasil	EM Alfredo de Paula Freitas	EM Isaias Alves	EM Eunice Weaver	EM Eng. João Thomé	GEC Embaixador Araújo Castro	EM Monteiro Lobato	EM Conjunto Praia da Bandeira
EM Santa Catarina	EM Djalma Maranhão		EM David Perez	EM Barcelona	EM Mario Piragibe	EM Francis Hime	E M Joana Angélica		EM Profa. Myrthes Wenzel.	EM Tenente Antonio João
GEC Celestino da Silva	EM Francisco Cabrita		EM Grécia	EM Figueiredo Pimentel	EM Otavio Kelly	EM Frederico Trotta	EM Jorge Jabour		EM Fernando de Azevedo	EM Haydea Vianna Fiuza de Castro
GEC Rivadávia Correa	EM Francisco Campos		EM odilon braga	EM Jose do patrocinio	EM pref. Marcos Tamoyo	EM Helena Lopes Abranches	EM Madre Benedita		EM IPEG	
GEC Rivadávia Corrêa	EM Gerog Pfisterer		EM Pres. Eurico Dutra	EM Jose Emygdio de Oliveira	EM Rosa da Fonseca (vila militar)	EM Mano Décio da Viola	EM Nações Unidas		EM Meralina de Castro	
GEC Vicente licinio Cardoso	EM Luiz Delfino		EM Fernando Tude de Souza	EM Maestro Pixinguinha	EM Rose Klabin	EM Republica da Colombia	E M Ramiz Galvão		GEC princesa isabel	
	EM Madrid		GCS -do samba Chile	EM Oswaldo Teixeira	Escola Antenor Nascentes	EM Roberto Burle Marx	EM Átila Nunes		EM Republica Arabe da Siria	
	EM Rodrigo de Mello Franco de Andrade			EM Presidente Eurico Dutra	EM Antenor Nascentes	EM Barão da Taquara:	EM COMENIUS		EM Deborah Mendes de Moraes	

CRE1	CRE 2	CRE 3	CRE 4	CRE 5	CRE 6	CRE 7	CRE 8	CRE 9	CRE 10	CRE 11
	EM Senador Correa			EM Cardeal Arcoverde		EM D. Pedro I	EM Engenheiro João Thomé		Escola Municipal Nelson Romero	
	EM: Benedito Ottoni			EM Gaspar Vianna		EM Finlândia	EM estado de israel		EM Prof. Eulalia Rodrigues de O. Vieira	
	EM Francisco Manuel			EM José do Patrocínio		GEC Aleksander Henrvk Laks	EM Lima Barreto		EM Narcisa Amália	
	GEC Orsina da Fonseca			EM Rugenda		GEC prof. Alberto Einstein	EM Mario Fernandes Pinheiro		GEO Doutor Socrates	
	EM General Humberto de Souza Mello			GEC Malba Tahan		GEC Rodrigues Alves	EM Miguel Ramalho Novo			
	GENTE					GEC Carlos Lacerda	EM Padre Lionel			
							EM Roberto Simonsen			
							EM Ruben berta			
							Escola da Bamba			
							EM Moacyr Padilha			
							EM Churchill			
							EM Gal. Tasso Fragoso			
							PET Pres. Medici			

Appendix X: BNCC (Brazilian Common Core) and technology in the pedagogical framework

The Brazilian Common Core recognizes the social changes caused by digital technology such as consuming and communication habits. The document states that technology is a competency that should traverse all school curriculum in a contextualized way. Technology should be considered as a method and a strategy to teach, and not as an instrument and a content per se; it should be used to model, illustrate, facilitate and introduce new perspectives in the teaching and learning process. However, despite those directions, many educators have a pretty extensive list why this is problematic. Some of those issues are easily perceived such as the lack of working computers and internet in schools, but some of them are much more complex as ownership, knowledge about, and use of technology entails concepts of equity, and social and economic inequality.

BNCC states that ICTs should be used in a critical, reflective and ethical way to share information, produce knowledge and solve problems, and suggests the specific competencies in the major curriculum subject areas:

- *Mathematics*: use mathematics tools, resources and processes to model and solve all sort of social problems, validating strategies adopted and results achieved
- Portuguese (Mother language):understand and use ICTs critically, reflectively and ethically to communicate, develop knowledge, solve problems, and engage in personal and collective projects using different languages and media.
- *Science*: Use ICTs to access, share, and communicate information; solve problems related to natural sciences ion a responsible, ethical, critical way.
- *English*: use ICTs to interact, develop research, select and share information, and develop understanding on the English language.
- *Art*: mobilize technological resources to record, develop research about, and create art.

Appendix XI: Questionnaire
The document is written in Portuguese. All the interviewers were Brazilians.

Questionnaire PAGE 1

Apresentação

Olá,

agradeço muitíssimo uns minutos do seu tempo para me informar sobre a sua prática!

Essa pesquisa tem um olhar para o professor e investiga como ele consegue pensar e realizar o seu trabalho a partir do momento que ele está só com os seus alunos...

Ao participar desta pesquisa você não terá nenhum benefício ou prejuízo, as informações coletadas são estritamente confidenciais, sendo assegurado o seu anonimato.

O questionário dura em torno de 12 minutos.

Caso tenha alguma dúvida sobre o questionário, envie-nos um email:

Pesquisadora Responsável:
Doutoranda em Educação: Paula Luderitz de Albuquerque Lenz-Cesar | paulaluderitz@gmail.com | Tel. (21) 998771415

Orientadora da Pesquisa:
Profª. Drª. Magda Pischetola | magda@puc-rio.br

Muito obrigada por participar!

=> De maneira voluntária, livre e esclarecida, concordo em participar da pesquisa acima identificada. Estou ciente dos objetivos do estudo, das garantias de confidencialidade e da possibilidade de esclarecimentos permanentes sobre os mesmos. Está claro que minha participação é isenta de despesas e que meu e-mail não será publicado sem minha prévia autorização por escrito. Estou ciente de que, em qualquer fase da pesquisa, posso recusar a minha participação ou retirar meu consentimento.

OK

*** 1. Participação na pesquisa:**

- ◯ sim, concordo em participar
- ◯ não, não concordo em participar

Questionnaire PAGE 2

*** 2. Estou atualmente lecionando no Ensino Fundamental II?**

- ◯ sim
- ◯ não

*** 3. Idade:**

- ◯ 21 a 30 anos
- ◯ 31 a 40 anos
- ◯ 41 a 50 anos
- ◯ 51 a 60 anos
- ◯ mais de 60 anos
- ◯ outro

*** 4. Tempo geral de docência (público ou privado):**

- ◯ 0 a 5 anos
- ◯ 6 a 10 anos
- ◯ 11 a 15 anos
- ◯ 16 a 20 anos
- ◯ mais de 20 anos

5. Tempo de docência no ensino público (em anos):
(digite um número)

*** 6. Area de certificação docente (marque todas que se aplicam):**

- ☐ Português
- ☐ Matemática
- ☐ Educação Física
- ☐ Educação Artística
- ☐ Especificacões:
- ☐ Geografia
- ☐ Ciências (especifique abaixo)
- ☐ Histórica
- ☐ Língua Estrangeira (especifique abaixo)

*** 7. Principal área de atuação:**

- ◯ Linguagens (Português, Língua Estrangeira, Literatura, Artes, Educação Física)
- ◯ Matemática
- ◯ Outro (especifique)
- ◯ Ciências Humanas (História, Geografia, Sociologia, Filosofia)
- ◯ Ciências da Natureza (Química, Física, Biologia)

Questionnaire PAGE 3

*** 8. Maior titulação de formação:**

- ◯ Ensino médio (formação de professores)
- ◯ Licenciatura
- ◯ Especialização
- ◯ Mestrado
- ◯ Doutorado

*** 9. Já realizou algum curso específico relacionado com Educação e Tecnologia?**

- ◯ sim
- ◯ não (vá direto para a questão 11)

10. Se você respondeu "sim" na questão anterior:

	fonte pagante	duração (em horas)
Curso 1		
Curso 2		
Curso 3		
Curso 4		

Nomes dos cursos: Por favor nomeie cada um dos cursos na espaço abaixo seguindo o modelo:
(curso 1: _____ , curso 2: _____ , curso 3: _____ , curso 4:_____)

nesta questão (10) o respondente poderia escolher uma opção em cada menu:

fonte pagante
- governo/secretaria de educação
- própria escola
- empresas ou ONGs
- instituição e ensino superior
- recursos próprios
- outros

duração (em horas)
- até 50 horas
- mais do que 50 e até 100 horas
- mais de 100 horas de formação
- outro

*** 11. Anos que leciona atualmente no Ensino Fundamental II:**

- ◯ 6o. ano
- ◯ 7o. ano
- ◯ 8o. ano
- ◯ 9o. ano
- ◯ Outro (especifique se for mais de uma série)

Questionnaire PAGE 4

*** 12. Quantas turmas leciona? (digite o número)**

*** 13. Quantos alunos tem em média cada turma?**

- ◯ até 20 alunos
- ◯ entre 21 e 30 alunos
- ◯ entre 31 e 40 alunos
- ◯ mais do que 40 alunos

*** 14. Selecione todas as tecnologias que estão presentes (acessíveis e funcionantes) na instituição em que você atua:**

- ☐ laboratório de informática
- ☐ computador em sala de aula
- ☐ laptop para uso de vários professores
- ☐ projetor em sala de aula
- ☐ projetor portátil
- ☐ Outro (especifique)
- ☐ *tablets* para uso dos professores e alunos
- ☐ internet banda larga
- ☐ lousa interativa
- ☐ televisão e vídeo/DVD
- ☐ nenhuma das opções acima

*** 15. Avalie cada uma das questões abaixo de acordo com o uso das tecnologias no seu cotidiano:**

***Eu utilizo mídias digitais* (divulgação de qualquer material com o uso de internet) para:**

	nunca	raramente	às vezes	quase sempre	sempre
investigar diferentes práticas de outros professores	◯	◯	◯	◯	◯
buscar conteúdos relacionados com a minha matéria	◯	◯	◯	◯	◯
planejar aula	◯	◯	◯	◯	◯
executar atividades diversas com os alunos	◯	◯	◯	◯	◯
avaliar aprendizado dos alunos	◯	◯	◯	◯	◯
comunicar resultados do processo de aprendizagem	◯	◯	◯	◯	◯
Documentar/registrar minhas práticas	◯	◯	◯	◯	◯

Outro (especifique e diga a freqüência)

Questionnaire PAGE 5

16. *Eu utilizo mídias digitais* para executar atividades diversas com os meus alunos como:

	nunca	raramente	às vezes	quase sempre	sempre
produção de texto	○	○	○	○	○
criação e uso de documentos colaborativos (Ex: Google Drive)	○	○	○	○	○
criação de blogs da turma	○	○	○	○	○
criação de vídeo/som/imagem	○	○	○	○	○

Outro (especifique)

17. *Eu utilizo as mídias digitais* para avaliar o aprendizado dos meus alunos através de:

	nunca	raramente	às vezes	quase sempre	sempre
produção de planilhas de cálculo	○	○	○	○	○
produção de texto	○	○	○	○	○
produção de fotos e imagens	○	○	○	○	○
realização de entrevistas	○	○	○	○	○
realização de dramatizações	○	○	○	○	○
produção de vídeo	○	○	○	○	○

Outro (especifique)

18. *Eu utilizo as mídias digitais* para comunicar sobre o processo de aprendizagem dos meus alunos para:

	nunca	raramente	às vezes	quase sempre	sempre
pais/responsáveis de alunos	○	○	○	○	○
direção da escola	○	○	○	○	○
próprios alunos	○	○	○	○	○

Questionnaire PAGE 6

* **19.** ***Quando eu investigo as práticas de outros professores eu:***

	nunca	raramente	às vezes	quase sempre	sempre
participo de portais educativos	○	○	○	○	○
observo aulas de outros professores	○	○	○	○	○
assino/acompanho publicações profissionais na minha área	○	○	○	○	○
me reúno com outros professores	○	○	○	○	○
acesso documentos compartilhados (ex: Google Drive)	○	○	○	○	○

Outro (especifique e diga a freqüência)

* **20.** ***Quando eu busco conteúdos relacionados com a minha matéria eu:***

	nunca	raramente	às vezes	quase sempre	sempre
leio jornais e revistas	○	○	○	○	○
pesquiso na internet de forma não estruturada	○	○	○	○	○
participo de congressos	○	○	○	○	○
acompanho/participo de blogs	○	○	○	○	○
acesso portais de conteúdo específico	○	○	○	○	○
acesso programas de TV	○	○	○	○	○

Outro (especifique e diga a freqüência)

Questionnaire PAGE 7

*** 26. *Após a minha prática eu documento (guardo/registro) os trabalhos feitos pelos alunos?***

- ◯ sim (identifique-os na questão 27)
- ◯ não (pule para questão 28)

27. Os trabalhos dos alunos são registrados...

	nunca	raramente	às vezes	quase sempre	sempre
no meu computador pessoal	◯	◯	◯	◯	◯
em um pen drive	◯	◯	◯	◯	◯
na nuvem	◯	◯	◯	◯	◯
na rede da escola	◯	◯	◯	◯	◯

*** 28. Após a sua prática as frases que mais lhe representam são (assinale todas as que se aplicam)**

- ☐ esta prática satisfez os meus objetivos pedagógicos?
- ☐ esta prática se realizou de acordo com o planejado?
- ☐ hora de pensar no próximo assunto a ser ensinado...
- ☐ o que posso fazer para melhorar a compreensão dos meus alunos?
- ☐ como outros profissionais estão trabalhando ou vão trabalhar este conteúdo?
- ☐ a minha prática estimula a autonomia do aluno?
- ☐ onde posso conseguir idéias e materiais alternativos para enriquecer a minha prática?
- ☐ existem formas alternativas para abordar este tema?
- ☐ como o assunto que foi abordado se relaciona com a minha postura e as minhas crenças como professor?
- ☐ a minha prática foi pensada/modificada em algum nível para atender a realidade socio-cultural dos meus alunos?
- ☐ vou registrar sucessos e complicações para depois revisá-los e talvez reutilizá-los no futuro?
- ☐ Outro (especifique)

Questionnaire PAGE 8

29. *Para o meu desenvolvimento profissional e melhora da minha prática eu:*

	nunca	raramente	às vezes	quase sempre	sempre
interajo com outros profissionais em projetos multidisciplinares	○	○	○	○	○
troco idéias e experiências com outros profissionais	○	○	○	○	○
observo aulas de outros professores	○	○	○	○	○
participo de um canal de colaboração online entre professores	○	○	○	○	○
analiso minhas próprias práticas passadas	○	○	○	○	○
participo virtualmente de um grupo de estudo	○	○	○	○	○

Outro (especifique e diga a freqüência)

*** 30. Assinale o seu grau de concordância com cada uma das afirmações abaixo:**

A tecnologia ligada a rede faz com que eu:

	discordo totalmente	discordo parcialmente	nem concordo e nem discordo	concordo parcialmente	concordo totalmente
a utilize na minha comunicação com os alunos	○	○	○	○	○
a utilize na minha comunicação com os responsáveis pelos alunos	○	○	○	○	○
colabore mais facilmente com outros profissionais	○	○	○	○	○
verifique o aprendizado dos alunos de formas diferentes (planilhas compartilhadas, vídeos, arquivos de som e imagem, por exemplo)	○	○	○	○	○
consiga observar os processos de aprendizado dos alunos e não só os seus produtos	○	○	○	○	○
registre (documente) minhas práticas	○	○	○	○	○
readapte material didático de acordo com o meu grupo de alunos	○	○	○	○	○

Outro (especifique)

Questionnaire PAGE 9

*** 31. Assinale o seu grau de concordância com cada uma das afirmações abaixo:**

A disponibilidade de recursos digitais modifica:

	discordo totalmente	discordo parcialmente	nem concordo e nem discordo	concordo parcialmente	concordo totalmente
os métodos pedagógicos adotados	○	○	○	○	○
as formas de avaliação praticadas	○	○	○	○	○
as oportunidades de aprendizagem	○	○	○	○	○
as formas de documentação e registro do professor	○	○	○	○	○
a freqüência e a intensidade da reflexão do professor	○	○	○	○	○

Outro (especifique)

*** 32. Utilize as escalas abaixo e avalie cada uma das afirmações de acordo com a comunidade escolar a que pertence:**

	nunca	raramente	às vezes	quase sempre	sempre
na reunião de professores surgem temas ligados ao uso de tecnologia	○	○	○	○	○
os professores compartilham práticas com tecnologias	○	○	○	○	○
compartilho minhas práticas com outros professores na minha instituição	○	○	○	○	○
a gestão pedagógica incentiva o uso de tecnologia: =>Para planejamento	○	○	○	○	○
=>Durante a prática	○	○	○	○	○
=>Para demonstração de resultados de aprendizagem	○	○	○	○	○
=>Na comunicação entre professores, alunos e responsáveis	○	○	○	○	○

Outro (especifique)

Questionnaire PAGE 10

*** 33. Percebemos uma atitude reflexiva do professor (reflexão sobre a prática) quando ele:**

	discordo totalmente	discordo parcialmente	nem concordo e nem discordo	concordo parcialmente	concordo totalmente
registra desafios e sucessos após a sua prática para uma análise futura	○	○	○	○	○
compara o planejamento de aula com o que de fato foi realizado e reavalia/readapta as práticas futuras	○	○	○	○	○
documenta/guarda as atividades realizadas, os planos de aula e os produtos dos alunos para uma avaliação futura	○	○	○	○	○
documenta/guarda as atividades realizadas, os planos de aula e os produtos dos alunos para uso futuro	○	○	○	○	○
verifica se os objetivos da aula foram atingidos e, se necessário, redesenha as próximas práticas	○	○	○	○	○
pensa e adapta a sua prática para que ela estimule a autonomia do aluno e o desenvolvimento de uma postura crítica	○	○	○	○	○
registra os conteúdos utilizados e produzidos em uma aula para partilha e troca de idéias com seus pares (críticas e sugestões)	○	○	○	○	○
planeja sua prática de acordo com o seu ambiente profissional e suas convicções em relação ao processo ensino-aprendizagem	○	○	○	○	○

Outro (especifique)

Questionnaire PAGE 11

* **34. Entendemos por documentação docente digital qualquer tipo de registro digital que o professor faz das suas práticas e/ou das diversas manifestações a ela relacionadas (avaliação de aprendizagem, planejamentos, comunicações, fotos de dinâmicas pedagógicas, exemplos de trabalhos de alunos, etc.)**

Na sua opinião, o ato da documentação digital do professor teria relação com um processo de reflexão sobre suas práticas?

○ sim ○ não

Por favor justifique brevemente a sua resposta:

* **35. Teria interesse e disponibilidade em participar de uma entrevista on line ou presencial sobre o tema abordado neste questionário?**

○ sim (informe o seu email abaixo) ○ não, obrigado.

Email para contato:

36. Se desejar, utilize o espaço abaixo para fazer qualquer tipo de comentário sobre este questionário e os temas abordados aqui.

Muito obrigada por participar!

Appendix XII: Focus Group Planning

FOCUS GROUP

documentation (digital), reflection (critical), change and transformation

" Could teacher documentation be an instrument of reflection?"

ENGAGEMENT INTERACTION PERCEPTION ACTIVITY SENSES
REFLECTION INSTRUMENTALIZATION DIDACTIC SCENE
DOCUMENTATION TRANSFORMATION

I.OBJECTIVE

Investigate and explore

- teachers practices - existence and habit of documenting (attention to the use of alternative words such as registration, portfolio)
- ways of identifying reflective behavior
- self perception as a reflective professional
- relations (if it exists) between reflective practices and transformative attitudes, the ones that seek changes
- possible indication of levels of reflection

II. LOGISTICS

Sections with 5-7 participants each.

Infrastructure:	**Registration**	**Team:**
• central workplace at downtown with easy access. • recorder • post-its, pens, paper, etc. • coffee-break	• audio recorder • individual post-its after the activities	• moderator (Paula Albuquerque) and two observers/note takers

III. SCRIPT

- **Opening:**
  - (3') clarifications about the investigation, confidentiality, and word choices for "documentation" in the Brazilian context.

- **Dynamics:**
  - teachers write 3 definitions/related words for each of the key words (available post-its)
    - documentation, technology, and reflection
  - teachers share their choices, justifying them, and comment on each other's choices
  - teachers write a sentence about their planning (what happens before and after), based on their own practice trying to contemplate those three key ideas
  - teachers share their sentences and comment on each other's

- *<u>I WILL BE LOOKING FOR:</u>*

Is technology contemplated during the planning process? Is technology contemplated during the documentation work? Is there any mention to the pedagogical process that we defined as "pedagogical scene"? Is there any relation among the three main concepts?

- **Indirect questions:**
  - *For you, what would happen if all teachers engaged in documentation*

work?
Whats is the impact that a systematic digital documentation could have in your practice? at your school? among your colleagues?
For you, what is the impact of digital (connected or not) resources…
for learning opportunities
for documentation methods and logistics
for teaching methods
for assessment and evaluation practices
on the intensity and frequency of reflective attitudes and practices
If you could choose a word to relate to documentation that word would be? (check for connection with the idea of transformation and change)
*What do you understand for **reflective documentation** ?*
does technology leads to documentation or documentation pre-existed? How is it?

- *I WILL BE LOOKING FOR:*

i) ways to think about the future, ii) reassurance about the role of documentation on a teacher's planning and practice, iii) relation among documentation, reflection and change, iv) identification of a critical reflective behavior (double loop)

- **Closure:** comments about the dynamics, pros and cons
  - what do you take from this?

IV. IMPORTANT OBSERVATIONS
Verify the different interpretations for terms used on the survey such as "learning opportunities", "pedagogical methods", "reflection habits and intensity" (see tabela 12 in section 6.3.2 consequences of the disponibility of digital resources) to check for consistency.

The availability of digital resources modifies...	Totally or partially disagree	Neither agree or disagree	Totally or partially agree
learning opportunities	2.6	1.3	**96.1**
documentation methods	1.3	3.8	94.9
pedagogical methods	3.8	3.9	92.3
assessment practices	9.0	2.6	88.4
reflection habits and intensity	9.0	9.0	82.0

ppendix XIII: Interview Outline

SEMI STRUCTURED INTERVIEW

documentation (digital), reflection (critical), change and transformation

" Could teacher documentation be an instrument of reflection?"

ENGAGEMENT INTERACTION PERCEPTION ACTIVITY SENSES REFLECTION INSTRUMENTALIZATION DIDACTIC SCENE DOCUMENTATION TRANSFORMATION

I.OBJECTIVE

Investigate and explore

- teachers documentation practices - existence and habit of documenting, registering pedagogical material
- use of digital technology when documenting
- motivations to document
- organization, logic and objectives of teacher's documents

II. LOGISTICS

Individual interviews at teacher's work place (schools)

Infrastructure:	**Registration**	**Team:**
• teacher's room • recorder • notebook	• audio recorder • pictures	• moderator (Paula Albuquerque)

III. INTERVIEW - clarifications about the investigation and confidentiality

- Focus points:
  - *reason*: habit, memory, usefulness, organization, sharing, marketing, personal marketing, personal archive, recycling, save work, ...
  - *place* (locus): drive, school computer, personal computer, pen drive, mobile phone, ...
  - *objective*: to reflect, to reuse, to share, …
  - *frequency*: rarely, usually, all the time, daily, …
  - *content*: autoral work, sample of students' work, repository, sample of work done, ...
- Additional questions about:
  - relation between available digital technology and habit and frequency to document
  - relation between practice improvement (if any) and documentation work
  - sharing, remixing, reusing, transforming materials
  - the meaning of their documentation work for them
  - participation, importance, perception of bodily manifestations (sentiments, sense, constraints) when documenting

- observation of teacher's documents, computer files, sample of documents (pictures, autoral work, videos, animations, texts, forms, etc.), organization of folders, logistics behind their choices.