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Analysing Teachers' Representations of Digital Technology Using a Grounded Theory Approach

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ABSTRACT

This research work describes the first work-package of an exploratory study, which examined a group of elementary school teachers' beliefs (representations) about digital technology in the French Polynesian context. The major objective of the study was to provide teacher education programmes with research-based information about the primary school teachers' beliefs and practices about digital technology. The study based its theoretical assumptions about teacher beliefs on the social representations theory and its research design on the grounded theory. The data were collected via interviews using theoretical sampling and theoretical saturation methods. Interviewing and analysis procedures were implemented concurrently through the systematic use of coding and iterative analysis processes. Research results indicated that internal factors such as interest in technology, teachers' DT skills and external factors such as support from administrators and technical maintenance played key roles in shaping teachers' DT practices.

Keywords: digital technology in education, grounded theory, social representations theory, teacher beliefs, teacher education

INTRODUCTION

The Internet, digital tools, and technologies for processing information and communicating are developing with remarkable speed. Digital technology (DT) tools have become cheaper, mobile and more accessible for everyone. They are evolving fast and spreading into individuals' personal living space and altering social habits, interaction types, and culture. Nowadays, the use of DT in the classroom is considered indispensable and schools in many countries provide students with digital tools and portable PCs. However, despite the increase in access to DT and technology training, DT tools are not being used sufficiently enough to support student learning. The exponential development of DT and the subsequent demand for its integration in education exert pressure on teacher education programmes to incorporate technical, didactic and pedagogical training in their curricula.

The French Polynesian society is not excluded from this influence, and more and more French Polynesian schools are equipped with digital tools. Since 2010, with the installation of the underwater fibre optic communication cable, which has connected French Polynesia to Hawaii, the broadband internet has been omnipresent in French Polynesian society. In 2015, an educational project called '*Digital Plan for Education*', was launched by the French Ministry of Education. This project reinforced the French Polynesians' wish for the creation of a '*Digital School*'. In recent years, the French Polynesian Ministry of Education has demonstrated a genuine desire to integrate DT into educational practices and made significant efforts to equip schools with digital material. The French Polynesian ministry of education aims at endowing all year 7 (6eme) and year 8 (5eme) middle school students with personal mobile equipment until the year 2019, and targets at generalizing the implementation of DT in all middle school classes. This endowment programme will also include primary schools upon their submission of a project. Since the endowments are often provided upon presentation of a pedagogical project, teaching advisors (TA) that are specialized in Information and Communication Technologies in Education (ICTE) have the task of training their colleagues in the development of such projects. This new endowment programme is also backed up with a large project that aims at providing teachers with pedagogical training on DT.

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Contribution of this paper to the literature

- This study is based on a social-psychological stance and explores teachers' DT beliefs using the social representations theory, which is a fairly new theoretical perspective for many international researchers.
- The study provides a step-by-step grounded theory research framework suitable for any DT belief study in any educational setting.
- The study bases its research focus on the results obtained in previous DT studies and uses these elements in its research frame to further investigate them.

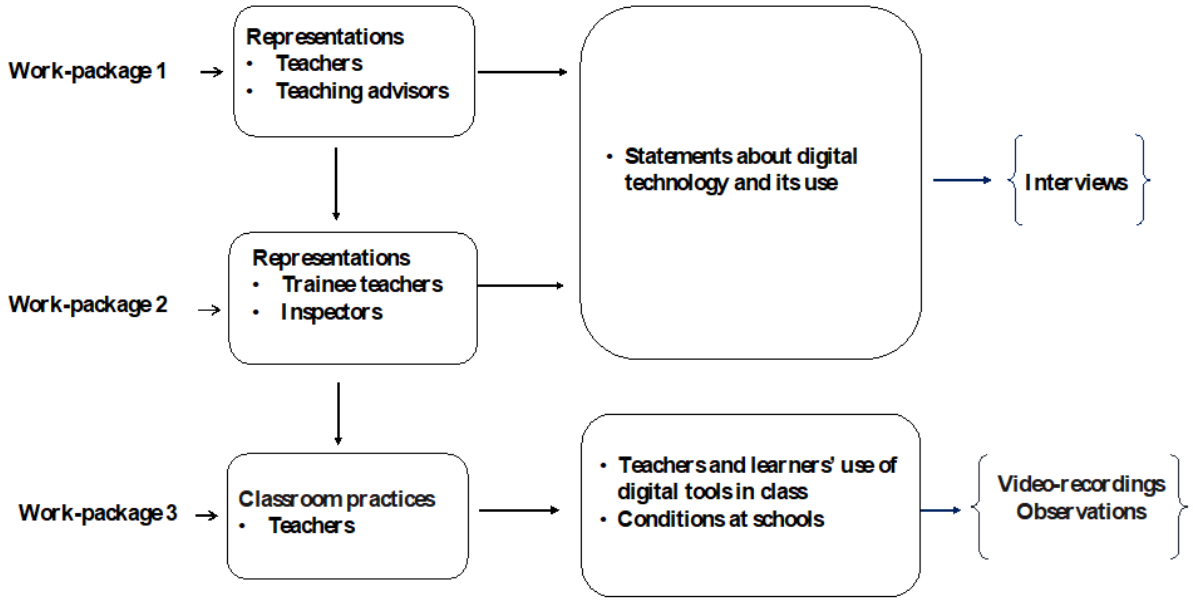

Figure 1. Research plan and work-packages

The ultimate objective of the present study is to provide teacher education programmes with research-based information about the primary school teachers' representations and practices about DT. The study attempted to find answers to the following questions: To what extent do teachers know about digital tools? How do they use them in their classroom? How does the use of digital tools change teaching practices and interactions in the classroom? What is the added value of these tools for learning? How do teachers feel about using these digital tools in their practices?

This work employed a three-phase research paradigm. The present paper deals only with the work-package 1. During the first work-package (see **Figure 1**), the researchers explored a group of elementary school teachers and teaching advisors' representations of digital tools using face-to-face interviews.

The second work-package is still in progress and will be available for the symposium Research Days in Education under the theme "Innovative pedagogies and new technologies in education" which will take place at the University of French Polynesia, in May 2018. During the second work-package, the researchers aimed at maximizing the participant variation by extending the interviews to teaching inspectors and trainee teachers.

In the last work-package, which has not yet started, the researchers aim to carry out classroom visits and use video-recorded data to examine teachers' practices and conditions at schools. The third package will employ classroom observations and video-recorded lessons, which were gathered during an extensive project called 'Pratiques Educatives Enseignantes et Parentales en Polynésie' (PrEEPP-Teachers and Parents' Educational Practices in Polynesia). The project took place between 2014 and 2017 and was funded by the following organizations: *Ministère des Outre-Mer* (Ministry of Overseas France), *Université de la Polynésie Française* (The University of French Polynesia), *Vice-rectorat de la Polynésie française, and the ESPE de l'Académie de Guadeloupe.* During this extensive project, a large, elementary school level, classroom corpus was gathered from five French Polynesian archipelagos.

Significance of the Study

Relevant literature on DT for education has suggested that enabling a lasting and efficient use of technology can only be promoted by adapting teacher training programmes to teachers' needs, learning contexts and conditions. The influence of teachers' beliefs on adoption and integration of DT in education has been a concern for many researchers (e.g., Abbitt, 2011; Brush, Glazewski, & Hew, 2008; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Steiner & Mendelovitch, 2017).

- This study contributes to the existing DT literature by looking at it from the teacher belief perspective. The novelty of the present study is that it looks into teacher beliefs using the social representations theory. The social representations theory is a well-established theory in French social psychology. However, this perspective is novel to many international readers.
- Although the study treats the DT issue in a French Polynesian context, it uses a specific research design (grounded theory approach) and some inquiry techniques that could be adopted in any educational setting. The researchers explain the research methodologies in a step by step manner and provide a well-defined research framework.
- The present study bases its focus of scrutiny on research driven elements which are considered as central in any educational setting. A significant number of research studies have argued that the benefits of digital tools and technologies depend, to a large extent, on a) teachers' representations, b) conditions available at schools, and c) teachers' digital and pedagogical competencies (Cuban, Kirkpatrick, & Peck, 2001; Ely, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2012). This study provides a framework showing how these aspects can be investigated.

THEORETICAL STANCE & LITERATURE REVIEW

This section provides a brief overview of the literature about the social representations theory (SRT), research done on teacher beliefs (representations) about adoption and integration of DT in teaching, and the grounded theory method (GTM). First, a brief account of SRT (Moscovici, 2000a, 1988) is provided by focusing on the concept of representations, their construction and their significance on individuals' thinking and actions. Then a short review of research on digital technologies for education is presented in association with teacher representations. Finally, GTM and the research procedures followed in this qualitative research inquiry are depicted (Glaser & Strauss, 1994; Strauss & Corbin, 1990).

Social Representations Theory

The concepts and theoretical perspectives about social representations were first developed by French scholars, who were specialized in social psychological research. However, the theory has received international acknowledgement and utilized by different scholars from diverse backgrounds (see Deaux & Philogène, 2001). The research paradigms used in this domain of inquiry bear parallelism with traditions in social constructionism and symbolic interactionism (Jovchelovitch, 2001). French sociologist Emile Durkheim (1898) was the first scholar who used the representations notion. However, social psychologist Serge Moscovici was the one who considered this concept as a phenomenon for the first time and developed it into a theory (Philogène & Deaux, 2001). Other French scholars such as Jodelet (1989), Doise, Clémence and Lorenzi-Cioldi (1992), and Abric (1994), also contributed to the elaboration of the concepts of SRT and the development of its theoretical framework.

The term 'representations' has been used to refer to common knowledge, self-beliefs, cultural beliefs such as stereotypes, collective cognitions, attitudes, prejudices, images and so forth (Moscovici, 2000a, 1988). Social representations are both individual and social and they carry the trademarks of society to which individuals belong (Abric, 1994). The term 'representations' has been used to refer to common knowledge, self-beliefs, cultural beliefs such as stereotypes, collective cognitions, attitudes, prejudices, images and so forth (Moscovici, 2000a). Representations can be in the form of contradictory ideas or thoughts in fragments that are linked to other everyday concepts (Abric, 1993). Despite their frivolous appearance representations are socially forceful and they help form a common understanding among people who belong to a group (Moscovici, 2000a, 1988; Duveen, 2000). Representations form a base on which individuals (co)construct other beliefs and cognitions. In return, these beliefs, cognitions, common knowledge, perceptions or aggregate of all these common understandings influence the decisions individuals make and actions they take (Abric, 1993, 1994; Gabillon, 2005; Moscovici, 2000b, 1988). Other theories in psychology and educational psychology are also supportive of the notion that beliefs (e.g., self-beliefs, self-efficacy beliefs, representations) have an impact on individuals' attitudes, motivations and consequently on their actions (e.g., Krause, Pietzner, Dori, & Eilks, 2017; Pajares, 1992; Weiner, 1980, 1985). SRT has been applied to a broad array of topics and domains ranging from education, health, science, new technology, identity and so forth (Abric, 1994; Bauer & Gaskell, 1999; Christidou, Dimopoulos, & Koulaidis, 2004; Gabillon, 2005, 2012).

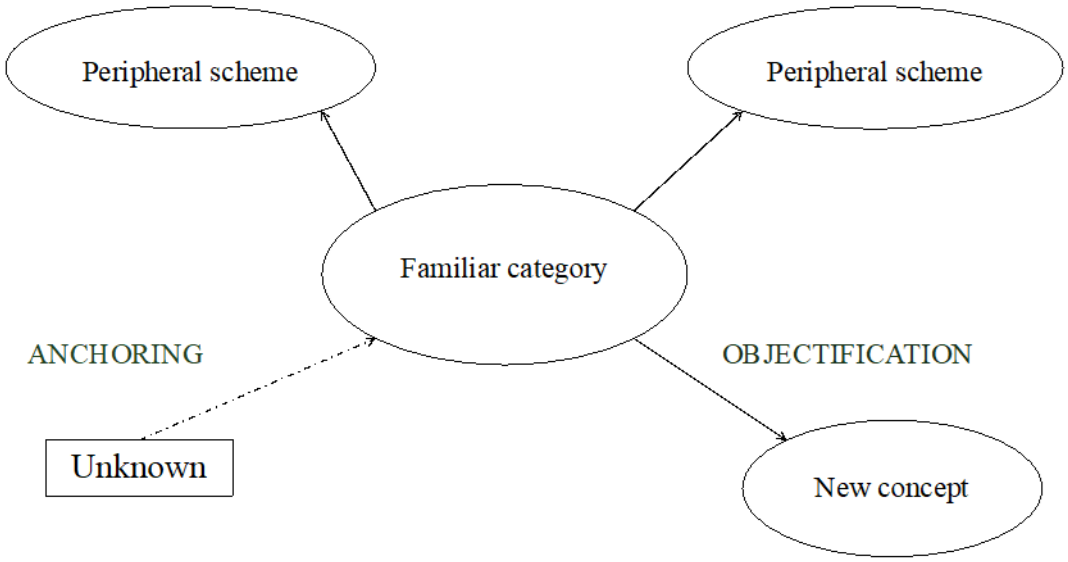

Figure 2. Schematic representation of Moscovici's objectification process (Gabillon , 2012, p. 197)

According to Abric (1994), social representations precede and determine the flow of interaction, and they shape individuals' behaviours and practices. Representations are considered as being in continuous interaction with context(s), subjects, and other social artefacts in individuals' environments (Doise et al., 1992). This view holds that the initial representations the individual has about an artefact will determine the nature of future interaction the person will have with that artefact. Thus, how the person will make use of that artefact will, for the greater part, depend on the initial representation that the individual has of the artefact (Doise et al., 1992).

Representations are not stable entities and can be (re)shaped through new experiences. Individuals may have positive or negative representations, and these representations can be influenced when new categories of ideas are formed through lived experiences. Moscovici's SRT is concerned with the process through which representations (i.e. beliefs, images, ideas, etc.) are produced, transformed, and transmitted to the social world (Duveen, 2000). Moscovici (2000a) maintained that the primary purpose of representations is to facilitate interpretations and form opinions. According to Moscovici (2000a, 2000b), comparing objects, ideas, individuals, events and so forth leads people to create classifications and link them to a prototype, which represents a category. He considered this classification system more than just a simple means of grading and labelling discrete entities (e.g., persons, objects, events, people's actions, etc.). Moscovici (2000a, 2000b) claimed that function of all representations is to turn something 'unfamiliar' into something 'familiar'.

Moscovici defined this process as composed of two complementary and interdependent mechanisms: Anchoring and objectification (Moscovici, 2000a). The first mechanism, anchoring is the process whereby the unfamiliar is absorbed into a known category. The second mechanism aims to objectify the unknown, that is, to turn something abstract into something almost concrete, which already exists in the individual's physical world (Moscovici, 2000a, 2000b). In other words, anchoring and objectification is a process whereby the individual transforms the unfamiliar into a more significant and easily comprehensible image. Moscovici (2000a) argued that such a process reassures and comforts people and re-establishes a sense of continuity. He sustained that during this process the familiar category often remains unaltered and the newly formed concepts, which are connected to this main category, are absorbed into this dominant category (see **Figure 2**).

According to Abric (1993), social representations have contradictory characteristics. They can be both rigid and flexible, and stable and changeable. To explain this phenomenon, he elaborated the concepts used in Moscovici's objectification process and developed the central core (central system) theory as a sub-theory of SRT (Abric, 1993). Abric explained that each belief is composed of a stable category to which peripheral schemes are connected. He named the stable category as the 'central core'. He maintained that ideas, metaphors, images form networks of related beliefs that are connected to one another around a core belief. He explained that this core belief stands for a prototype. In SRT the central core is considered as a dominant representation which is resistant to change. A peripheral representation, on the other hand, is a newly formed representation, which is more flexible and less resistant to change. According to Moscovici (2000a), central cores are social representations (i.e. social/cultural

beliefs) which are created in society by members of that society. Abric (1993) stated that core representations express permanence and uniformity and they dominate peripheral schemes. Whereas, peripheral schemes express variability and diversity. He maintained that the central core is "… stable, coherent, consensual and historically marked…" and the peripheral scheme is "…far more sensitive and determined by the immediate context characteristics." (Abric, 1993, p. 76). He also added that peripheral schemes support heterogeneity of the group and allow the integration of individual experiences, adaptation to concrete reality and content differentiation.

Teacher Representations and the Link between the Use of DT

Several studies examined the relationship between teachers' representations and adoption and integration of technology in teaching and investigated the factors that influenced teachers' practices (Abbitt, 2011; Brush et al., 2008; Ertmer et al., 2012; Pelgrum & Plomp, 2008; Pilkington, 2008; Prestridge, 2012; Voogt & Knezek, 2008). These studies employed both quantitative and qualitative research methodologies and collected data essentially through questionnaires, interviews, and observations. In many of these studies, teachers' beliefs (representations) and the use of DT tools for education were investigated in relation to: a) teachers' technical and pedagogical competencies, b) teacher development and preservice education, d) availability and management of DT tools, e) evolution of teaching practices and so forth.

Many research studies that examined teachers' representations used the term beliefs (e.g., self-efficacy etc.). The results obtained from these studies have indicated that there are correlations between teachers' representations and their practices and that teachers' representations, skills, and attitudes are interdependent (Abbitt, 2011; Brush et al., 2008; Summers, 1990; Steiner & Mendelovitch, 2017). Many researchers sustained that, negative representations, due to lack of knowledge about digital tools, would have a direct consequence on teachers' emotions and attitudes (e.g., fear, reticence, caution, etc.) and would influence their confidence in using these tools. In contrast, positive representations would correlate positively with teachers' feelings, attitudes and subsequently with their actions (Abbitt, 2011; Berney & Pochon, 2000; Ertmer et al., 2012; Felder, 1989; Prestridge, 2012; Rinaudo, 2002; Windschitl & Sahl, 2002, etc.).

Research findings have indicated that teachers' behaviours can be influenced more by their representations of an artefact than by the knowledge about the artefact in question, especially in cases when interaction with the object is minimal. However, regular interaction and subsequent experience resulting from this interaction can modify the individual's representations because this dynamic and reciprocal influence between representation and interaction generates a mutual evolution (Abric, 1993; Prestridge, 2012). Research outcomes obtained from a meta-aggregative analysis of 14 studies on integration of technology in education proposed that in association with regular use of technology, teachers often change their classroom practices (Arnold, Padilla, & Tunhikorn, 2009; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). Other research studies on teachers' beliefs about DT also suggested similar links between teachers' beliefs and their attitudes towards the use of digital technology (Abbitt, 2011; Brush et al., 2008; Ertmer, 2005; Windschitl & Sahl, 2002).

Results obtained from different research studies have revealed strong links between teachers' use or non-use of DT in teaching and their conceptions of student learning and (Riel & Becker, 2008). The results obtained from some studies demonstrated that teachers, who believed that it was their role to foster collaborative learning and independent individual student work, tended to use DT more frequently (Windschitl & Sahl, 2002). Conversely, teachers who felt that they were required to teach what the curriculum stipulated had tendencies to avoid the use of digital tools. The outcome of these studies also indicated connections between teachers' representations about their professional competencies and the integration of DT in their teaching. The results suggested that teachers who believed that using digital tools required a good command of technical skills (which they believed they did not have), avoided using DT with their students (Ertmer et al., 2012; Windschitl & Sahl, 2002).

Some research results also indicated that teacher representations that consider digital tools as 'ordinary tools' or 'technical instruments' would not be conducive to the integration of DT for learner use. Teachers who see digital tools no other than simple devices will not take a reflexive stance that favours the integration of such tools in classroom practices (Baron & Bruillard, 1996; Ertmer et al., 2012; Karsenti & Larose, 2005). Baron and Bruillard's (1996) findings suggested that teachers who were still in training considered DT as not being indispensable as an educational tool in the teaching/learning of disciplinary knowledge. A decade later Aoudé (2007) reported similar results. In Aoudé's study, the participants, who were also trainee-teachers, stated that they used digital tools more in lesson preparation and much less during activities with their students. Béziat (2012) asserted that trainee teachers' representations of DT are influenced by their previous experience as student users at school, and these representations influence their disposition regarding the use of DT in their classrooms. Thus, Béziat suggested that teacher education programmes should intervene on the representations of trainee teachers by introducing the use of DT as early as possible in teachers' professional education. Results obtained from a study carried out by Wang, Ertmer, and Newby (2004) showed that teacher education programmes could influence preservice teachers' beliefs,

and therefore their confidence in becoming efficient technology users within their classrooms if such teacher education programmes provide them with a vicarious learning experience.

Grounded Theory Method

The grounded theory method (GTM) was formulated by sociologists Glaser and Strauss in the late 1960s. This qualitative research approach originated within the symbolic interactionist school of psychology (Baker, Wuest, & Stern, 1992) and it is used to generate a comprehensive theory to understand social and psychological phenomena (see Glaser & Strauss, 1994; Strauss & Corbin, 1990, 1997). The research traditions used in this school of inquiry share similarities with practices employed in social constructionism and social psychology (Bryant, 2017; Strauss & Corbin, 1997). The symbolic interactionist perspective assumes that people are motivated to look for meaning in their behaviour and that they act in accordance with their subjective understanding of the situations in which they find themselves. GTM is used in disciplines that aim to discover significant aspects of human experiences, and it is employed to capture, understand, and explain lived experiences of people (Baker et al., 1992; Charmaz, 1996). GTM provides researchers with a series of logically consistent research techniques and strategies to conduct rigorous qualitative research studies. These interpretive research methods are especially suitable for studies that intend to discover participants' meanings, perceptions, emotions, attitudes, beliefs and so forth. GTM is, inductive, iterative and an interactive inquiry which necessitates entering the participants' world and gathering as complete accounts as possible (Charmaz & Belgrave, 2012).

The terms which are associated with GTM are theoretical sampling, theoretical saturation, purposeful sampling, and coding (e.g., open and axial coding). Theoretical sampling is one of the central concepts of GTM. The term was introduced to the literature with the discovery of GTM by the sociologists Glaser and Strauss. Theoretical sampling is a data collection process with a primary objective of generating theory. During this process the analyst carries out a series of concurrent data collection and analysis procedures and decides what data to collect next. This process involves collecting, coding, comparing, linking, and integrating data into relevant categories (Glaser & Strauss, 1994; Paillé, 1994; Paillé & Mucchielli 2003; Strauss & Corbin, 1990, 1997).

Data collection, concurrent comparative analysis, and category formation procedures continue until each category is saturated. In other words, the theoretical sampling processes end when the data collection procedures can no longer obtain new information and the analysis procedures cease to generate new categories (Charmaz, 1996). This stage is referred to as theoretical saturation, and this saturation point determines the definitive sample size (Becker, 1993; Becker & Stamp, 2005; Glaser & Strauss, 1994; Paillé, 1994; Paillé & Mucchielli 2003; Strauss & Corbin, 1990).

In GTM sampling is carried out using specific procedures. Sampling procedures should not be confounded with theoretical sampling, which is "…sampling for theory construction, not for representativeness of a given population, to check and refine the analyst's emerging conceptual categories." (Charmaz, 1996, p. 28). When a research project begins, based on the phenomenon the researchers intend to investigate, representative groups of individuals are selected. In GTM researchers go to groups from whom they can obtain rich information about issues crucial to the purpose of the research (Corbin & Strauss, 1990; Strauss & Corbin, 1990). The initial purposeful sampling is usually based on similarities or/and maximum variation principles with an aim of obtaining the maximum of information on the phenomenon in question and maximizing the representativeness of the primary data. Initial sampling is usually based on similarities principle, and the researchers select a group who has the characteristics that are shared by all members (e.g., social identity, occupation, educational background) and are representative of the phenomenon in question. Maximum variation is used when researchers desire to maximize the variation (e.g., age, gender, class, etc.) within the sample. The aim of maximum variation is to ensure the presence of maximum variability within the primary data.

Coding is the central inquiry process used in GTM. Open and axial coding are two most commonly used analysis methods. Open coding is mainly used at the initial stages of the inquiry processes. It involves comparing ideas, interactions, events, and so forth for similarities and differences and assigning them conceptual labels (codes). In axial coding, categories are linked to their sub-categories, and the relationships tested against data (Corbin & Strauss, 1990; Strauss & Corbin, 1990).

METHODOLOGY

The study was designed following the methods and procedures employed in GTM (see Glaser & Strauss, 1994; Strauss & Corbin, 1990). Respecting the grounded research traditions, the researchers started the analysis procedures as early as the first interview at the outset of the study. The data gathered through interviews were treated by applying theoretical sampling and theoretical data saturation methods using concurrent analysis schemes such as coding, sorting, linking, and forming categories (Glaser & Strauss, 1994; Strauss & Corbin, 1990). These research strategies enabled the formation of categories and a gradual construction of the definitive sample

size. The use of the theoretical saturation method also provided a means for triangulation by ensuring that the data represent all facets of the investigated phenomenon. Besides the theoretical sampling processes, the transcribed corpus was also subjected to double checking by the interviewees themselves. That is, the interviewees were provided with the transcribed data, and they were asked to verify the content for accuracy and add information or correct the content if they felt necessary.

Data Collection

The dataset for the study was gathered by conducting semi-directed face-to-face interviews, and the data gathering and analysis procedures took place from April until the end of September 2017. Sixteen elementary school teachers from Tahiti, French Polynesia, participated in the research.

Face-to-face interview technique is considered as a suitable data collection instrument in qualitative inquiry, and its use is recommended by the proponents of GTM. Interviews provide contextualized and in-depth information. Moreover, they are rich in discourse features such as emphasis, choice of vocabulary, repetitions, and social cues such as voice, intonation, body language and so forth. As such interviews provide a great deal of extra information that adds value to this qualitative research technique.

Before using the interview questions with the participants, the researchers consulted other researchers' opinions. The initial set of questions were tested with two teachers. These two preliminary interviews were not included in the actual research corpus. Following these two interviews, the researchers transcribed and analysed the interview data and readjusted the questions and consulted two other researchers to check the adjusted questions. After some modifications, the final set of questions were formed and used with the other participants.

To minimize the interviewer bias (e.g., personality, experience, etc.) and to provide coherent continuity, the same researcher conducted all 16 interviews. The interviewer was a senior researcher who had experience in qualitative research techniques, and during the interviewing process, she adapted the order and the content of the questions according to the statements obtained from the interviewees. The following interview questions were used in this first work-package:

1. When did you last use DT?
2. What do you think of your practices regarding the use of digital technology in class?
3. Do you think that the use of digital technology could influence classroom practices/interactions? If yes, how?
4. Do you like using digital technology in your practices?
5. Did you take part in an in-service training programme/event about digital technology? (If yes) How did you feel about it? (What do you think about it?)
6. Do you think that the acquisition of digital skills is necessary (for teachers and students)?

To ensure the secure collection of the corpus and to avoid any technical problems, the recording of the interview corpus was carried out with two recording devices: a) a professional audio-recorder and b) a personal smartphone. The duration of the interviews ranged from 45 to 70 minutes.

Participants

The sampling procedures were carried out at three levels (see **Figure 3**). The researchers carried out: (i) purposeful sampling by applying the similarities and maximum variation principles to obtain rich information; and (ii) the theoretical saturation principle to determine the ultimate sample size.

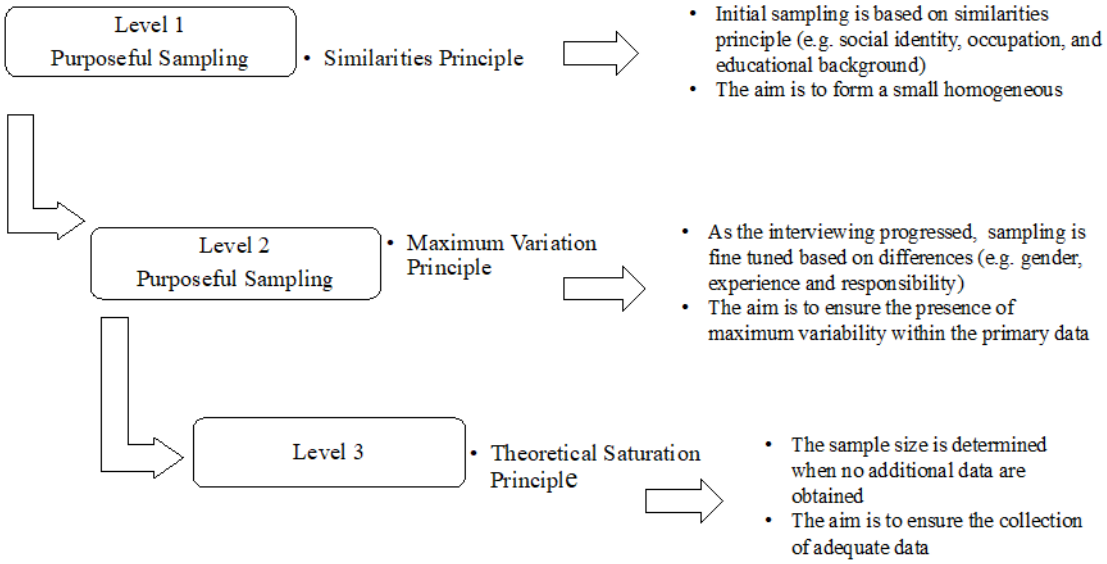

Figure 3. Three-level sampling model used by the researchers

Table 1. General characteristics of the participants and the length of the interviews

Primary School Teacher (T)				
Age	**Gender**	**Experience/years**	**Education Zone**	**Duration of the interview**
43	Female	11	Tahiti	70
40	Female	17	Tahiti	45
44	Female	24	Tahiti	50
35	Female	13	Tahiti	55
42	Male	18	Tahiti	41
33	Male	11	Tahiti	41
37	Male	15	Tahiti	63
45	Male	25	Tahiti	58
Teaching Advisor (TA)				
52	Female	33 (11years as TA)	Tahiti	60
47	Female	27 (?)	Tahiti	54
47	Female	27 (9 years as TA)	Tahiti	44
46	Female	26 (9 years as TA)	Tahiti	54
41	Male	22 (10 years as TA)	Tahiti	49
50	Male	28 (18 years as TA)	Tahiti	53
38	Male	16 (5 years as TA)	Tahiti	55
43	Male	23 (10 years as TA)	Tahiti	67

Note. N=16 (T n=8 TA n=8)

This research study was concerned with elementary school teachers' representations regarding the adoption and integration of DT in teaching, and the researchers looked for characteristics that were shared by all participants. Thus, the first level was concerned with constituting a group of participants who were the most representative of the phenomenon in question. During the first stage, the researchers used a purposive sampling method focusing on the similarities that characterized the group: The participants were selected on the bases of the following initial criteria: (i) similar educational background (i.e., lived and educated in French Polynesia); (ii) same cultural identity (i.e., French Polynesians); and (iii) similar work experience (i.e., worked in a French Polynesian primary school). After defining the characteristics regarding similarities, the researchers looked for differences within this uniform group by applying the principle of maximum variation (e.g., experience, gender, age, and responsibilities) (see **Table 1**).

The sample group size was determined through theoretical sampling processes. The maximum variation was established gradually during the theoretical sampling processes. As the interviewing progressed, sampling was fine-tuned and equalized based on differences (e.g., experience, gender, responsibility, etc.). The aim of this process was to ensure the presence of maximum variability within the primary data. The final participant number (after

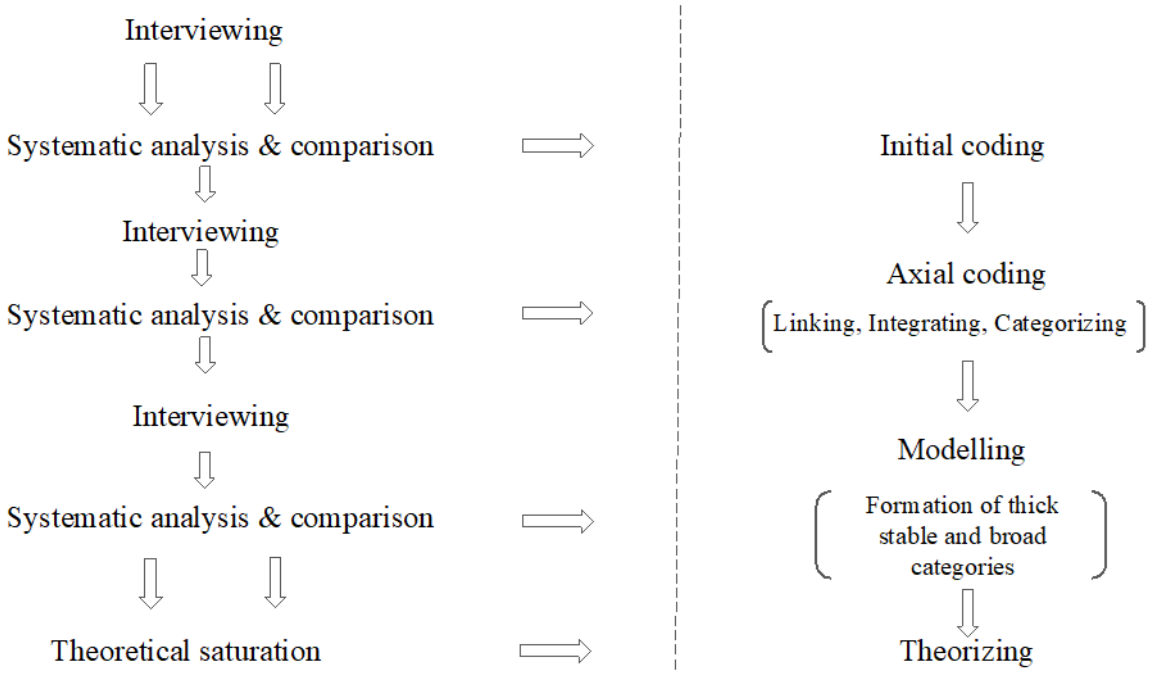

Figure 4. The grounded theory methodologies the researchers followed

theoretical sampling and theoretical saturation procedures) were 16 teachers: Eight men and eight women, eight teachers and eight teaching advisors, teachers within the age range of 33 to 50, and teachers with 11 to 23 years of teaching experience.

Analysis Methods

The researchers followed the steps suggested in GTM: coding, categorization, forming of broad categories, linking, integration, and theorization (the researchers intend to delay the theorization stage until the completion of all three work-packages). At the initial stages, the researchers used open coding (vivo coding), and as they progressed in the analysis procedures, they discovered distinct ideas and labelled these properties to create new categories. After the initial coding procedures, using axial coding, they aggregated the lower level abstractions as 'sub-categories' and then through iterative inductive processes they assigned characteristics to different data groups. **Figure 4** illustrates the theoretical sampling, constant comparative analysis, coding, theoretical saturation and theorizing processes the researchers followed in the study.

The researchers identified initial categories from the most frequent occurrences. Then, through axial coding, they identified new groups and other higher-level categories to which they progressively added new properties and finally grouped all these categories under macro-categories. The categories generated via this study were gathered under the following mega-categories: (i) teachers' representations of the notion of DT; (ii) teachers' statements about the use of DT; (iii) teachers' statements about their students' use of DT in class; and (iv) teachers' stated feelings about the integration of digital tools in their teaching practices.

After the eleventh interview, the data reached saturation, and the researchers did not discover any new categories. However, they continued the interviewing processes until the sixteenth interview to establish maximum variation. Maintaining interviewing helped to establish a balance between the sub-categories and provided data to make comparisons between different participant groups (i.e., man/woman, teacher/teaching advisor, experienced/less experienced, etc.). Relevant literature maintains that data saturation may occur before 12 interviews (Guest, Bunce & Johnson, 2006). Griffin and Hauser's (1993) study illustrated that with 20 interviews one could obtain 90% of the information that can be obtained with 30 or more interviews. In this first work-package, our study used a very homogenous sample size, and this may explain the saturation after eleven interviews.

RESULTS

This article presents the preliminary results of a study which comprises three work-packages. In this first work-package, the researchers did not attempt to theorize the categorized phenomena, and the results presented in this study have an exploratory character.

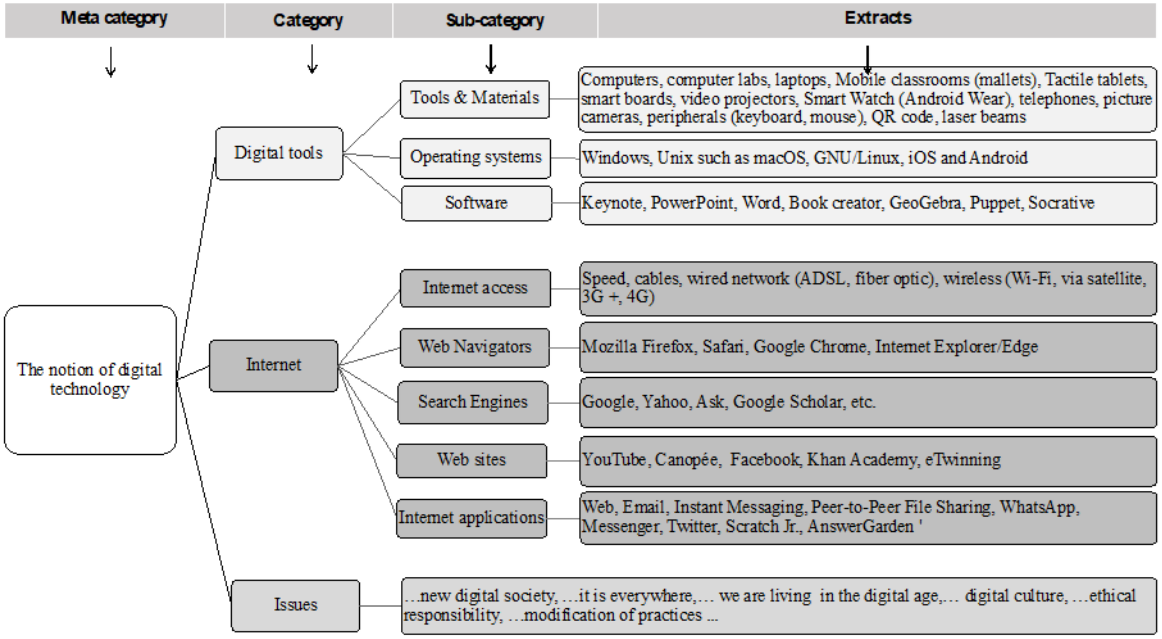

Figure 5. The teachers' representations of the notion of DT

The Teachers' Representations regarding the Notion of DT

One of the objectives was to gather information about the teachers' representations on the notion of 'digital technology'. The interview corpus concerning this aspect was coded and examined through systematic comparison and analysis procedures (i.e., iterative inductive processes). Throughout the interviewing, the data properties concerning the notion of DT, linked and integrated into different levels of abstractions and the sub-categories were organized into three hierarchical categories (see **Figure 5**).

The transcribed data revealed that the respondents did not have the same level of familiarity with DT. The analysed corpus indicated that some teachers had very limited knowledge on DT both at personal and professional levels. Some teachers developed and refined their ideas with precise descriptions of some digital tools. However, some other teachers gave short responses in the form of basic concepts without developing their answers. It should be noted that the most cited concepts were about the commonly used materials and tools (e.g., the internet, email, social networks, etc.). The statements obtained from a few teachers indicated that they knew about varied technical tools, materials, applications, and sophisticated technical concepts that are reserved to competent users (e.g., web browsers, operating systems, UNIX, HTML, programming tools, etc.).

More than half of the interviewees expressed a link between DT and the importance of its purposeful and ethical use:

> *"(...) behind each material; there is also an approach that must be used while teaching. (...) cannot use it as you do in traditional teaching, (...) the approach allows taking a professional stance (...) without also forgetting the whole ethical responsibility part about these uses. "*

The Teachers' Statements about the Use of DT

In this macro-category, the researchers grouped the teachers' statements about the use of digital tools and their classroom practices together. This mega-category also included teachers' statements about classroom activities in which digital tools are used and the benefits of these tools. **Figure 6** summarizes the teachers' statements regarding the use of DT in their classrooms.

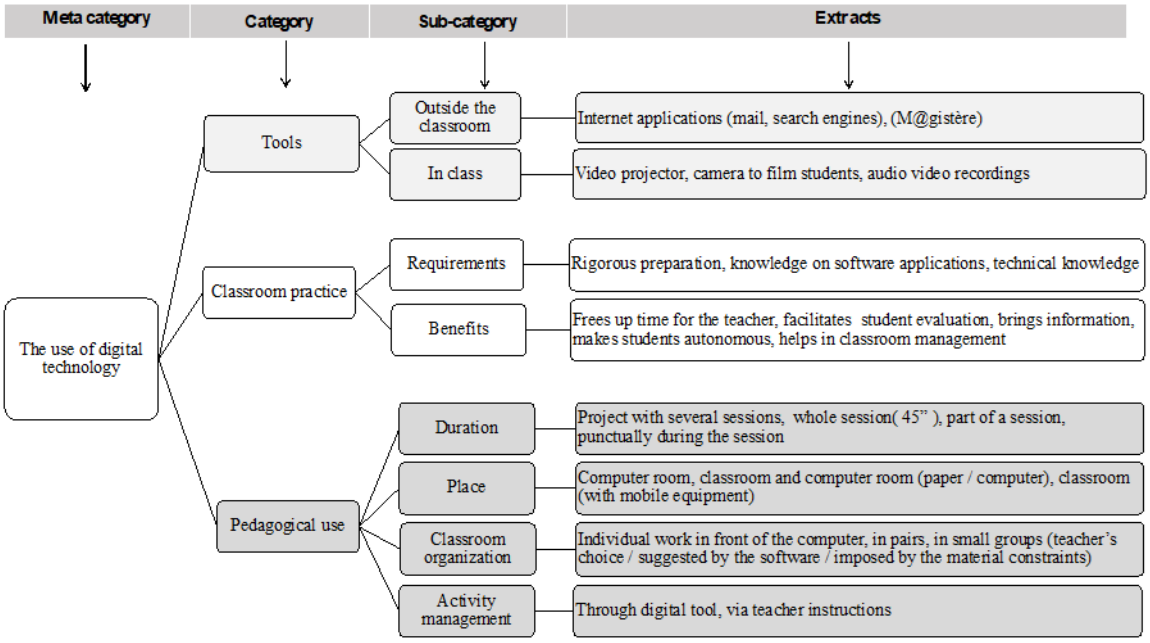

Figure 6. The teachers' statements about the use of DT

Most of the interviewees maintained that the integration of DT in teaching practices requires both technical and pedagogical knowledge and laborious work that demands extra preparation time. They repeatedly stressed the necessity of detailed preparation and foreseeing possible problems in advance:

> *"The preparation time of an activity is quite huge (...) everything has to be fixed and done in advance (...) in the computer room, if I do not think about and prepare everything in advance, (…) (if it is not done properly) they (pupils) will drop the activity, (...) they will be difficult to manage (...) it is important that pupils are at ease when they start the tasks (...) is necessary that the students are all engaged in the activity, and maintain this attention during the duration of the activity."*

Some teachers also explained that in the classroom, they had to manage their students' pedagogical needs, tools and other requirements about tasks simultaneously:

> *"(…) if we do not give clear instructions before they arrive in the computer room, it is chaos (...) everything goes in every way (…) I act according to my students' needs (...) demands; there are sometimes things that I cannot think of in advance."*

The teachers maintained that the wise use of digital tools necessitates modification of common teacher-learner interactions and teaching-learning practices:

> *"They work alone (…) they are autonomous (…) many (students) believe, that they can take the information from the Net (Internet), and can use it without adapting, without appropriating really what they need to do (…) but as teachers, we must know how to use them (tools), and the teacher must teach the pupils, the children how to use these tools."*

The teachers also stated that the teacher's presence during DT tasks is indispensable:

> *"Digital tools will never replace the teacher (…) the teacher-learner interactions are not the same as interactions between the learner and the tool (…) if there's no teacher to show him/her how to do it (...) the digital tool will not do the teacher's work alone."*

The Teachers' Statements about the Learners' Use of DT in Class

The statements which were about the uses of DT by learners were gathered under a distinct category (see **Figure 7**).

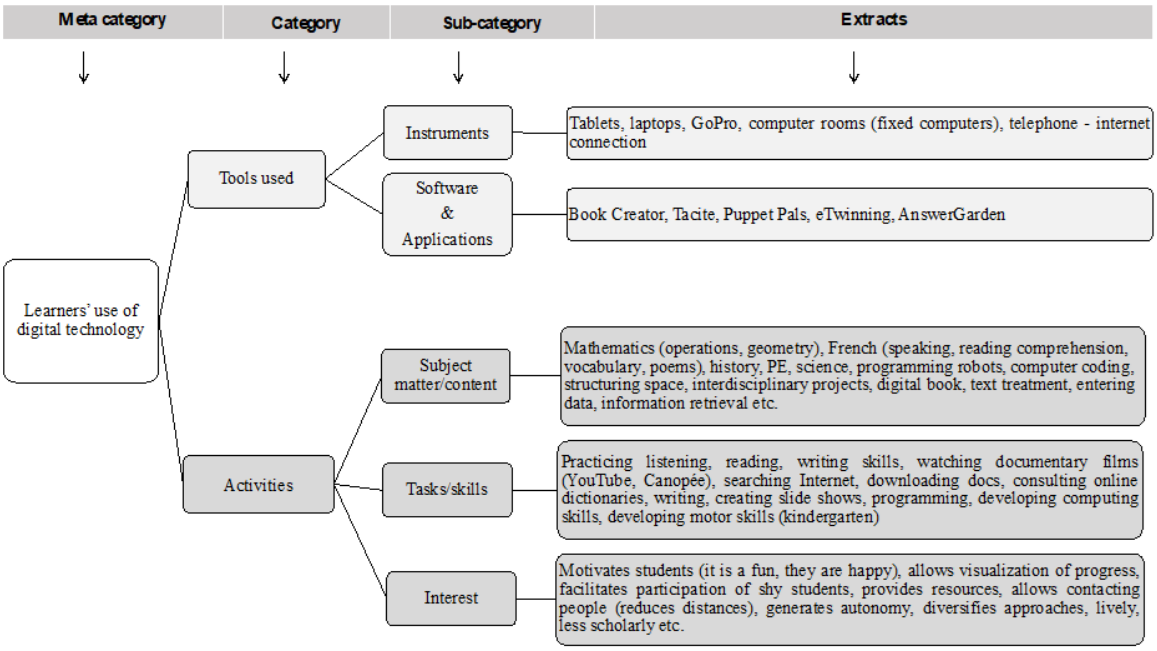

Figure 7. The teachers' statements about the learners' use of DT in class

All teachers, stated that digital tools have advantages and are motivating for students:

> *"They (students) love it. They love it, (…) but because it's not academic (...) it's fun. They do not have computers at home. (…) They do not have IPads at home, not often (…) and in any case no internet (…) coming to the class and having a computer, it's fun (...) like a game session… Such tools can be very useful for the students with learning difficulties or special needs."*

Some teachers pointed out some positive aspects of DT tools regarding learner errors:

> *"(...) they are no longer blocked by fear of making an error. (...) being able to self-correct and to go back without leaving any trace (...) it's always tidy (...) no mess (...) favours enormously students with learning difficulties… good for collaborative writing (...) with a computer, when one makes corrections, one produces a clean piece of work. There is no erasure, barring, erasing (...) For children, it still has another value to produce a clean piece of work (…)"*

Some teachers linked the issue concerning error correction to self-concept:

> *"I would like to mention its connection with children's self-esteem (...) On tablets, I see that they are not afraid to be wrong… when they write on a piece of paper, and when there is a mistake, they have difficulty in erasing it. They do not want to hand in their work anymore. There is a written trace (…) they have trouble with (...) so they prefer not to write anything because they are not sure of their answers, whereas on the tablet it is easily done (...) when it is wrong, they erase everything, and they can go back and revise (...) neither seen nor known (...)"*

The teachers also described in which situations and with which school subjects they used digital tools. The teachers' answers indicated that they used digital tools and software applications in teaching different school subjects. **Table 2** provides examples through which the teachers described how they used these tools in their teaching practices.

Table 2. Examples of school subjects that use digital tools in classroom activities

Reading, comprehension & vocabulary	- "The digital tools are used during the practice phase (…) on a notion that they have already seen (…)" - "(…) with 6th grades, we do comprehension activities by using an application called *Tacitus.*" "(…) it is a software application for vocabulary practice with children, but they have to go online." "(…) to improve comprehension skills."
History	- "(…) the films in history classes" - "They searched the kings of France. So, they had a guide sheet, and they had to navigate to answer the questions (…)"
Mathematics	- "(…) with Geogebra they do geometry (…)"
Computer programming	- "(…) we used the laptop (…) to be able to do computer programming. (…) this programming serves to move small robots, (…) playful "
Physical education	- "The use of video in PE. Pupils are in a situation of a game, (…) student films (…) they are autonomous, the students re-watch the film. (…) you do a lot of work with them, (…) you observe the role of each person (…) improve learning as well, gestures or techniques or tactics of the game, which is done precisely through video (…)"

Table 3. Negative and positive representations of DT

Positive Representations	**Negative Representations**
Digital tools:	- Demanding preparation & time
- Improve classroom dynamics	- Replacement of material due to the rapid evolution of DT
- Bring openness to the world and resources teachers use (M@gistere and MOOCs)	- Complexity of DT and its rapid evolution
	- Lack of appropriate digital material
- Reduce teaching time (evaluations, correction of the notebooks ...)	- Pupil-teacher proficiency gap (some students can be more competent)
- Increase learners' self-esteem	- Difficulties regarding classroom and material management
- Allow autonomous work and scaffolding by software	- Reluctance related to time and additional work to prepare an activity
- Meet student expectations	- Resistance to change
- Encourage collaborative learner work	- Desire to keep to usual practices
- Provide help for learners with learning difficulties	- Difficulty of getting contextualized training to answer personal needs (relevant training)
- Help diversify learning approaches	
- Motivate students	- Denial of use due to lack of skills or bad experience
- Provide an added value for the course	- Non-availability of permanent technical maintenance

The Teachers' Stated Feelings about the Integration of Digital Tools in Teaching Practices

After forming general categories, the researchers regrouped the statements about the teachers' feelings under two broader areas and presented these broader categories as positive and negative representations. Thirty-six percent of the coded statements expressed favourable opinion towards DT and its use in the classroom. Sixty-four percent of the participants' coded discourse contained some elements which pointed to problems. These negative statements, however, primarily expressed either difficulties that teachers faced and that needed to be resolved or reasons and explanations for non-use of digital tools. The researchers did not record any arguments "against" DT tools or their use in the classroom. Although the expressions that mentioned the positive aspects of digital technology came up in every interview, the arguments mentioning difficulties and problems were in the majority (see **Table 3**).

Regarding the stated difficulties the results pointed to some discrepancies between the school teachers and teaching advisors' viewpoints. Especially, about the issues and problems related to teacher training these two groups seemed not to share the same views (see **Table 4**). This discrepancy could be explained by their respective roles. Teaching advisors, apart from their teaching role, are also teacher mentors who provide teachers with support in their teaching in French education system. **Table 4** presents some extracts from the interview corpus which point to discrepancies in these two groups' statements.

Table 4. Discrepancies between the teachers and teaching advisors' statements about problems

Type of difficulty	Teachers	Teaching Advisors
Pedagogical	- Difficulty in following students' work, reasoning, analysing their errors	- Difficulties related to the wise use of digital tools (added-value) - Divergence from pedagogical principles (too much focus on the use of the tool)
Training	- Difficulty to have training - None or few useful or personalized training that answers actual needs - The discrepancy between training received and available digital tools at school for student use	- The difficulty of identifying teachers' needs - Non-interest in training - Training requests which are not always relevant (or difficult to answer) - Non-use of training received in class
Personal	- Non-use related to fear of DT - bad previous experience	- Teacher resistance to DT - Fear of being replaced by technology
Digital tools	- Demanding requirements and formal procedures to obtain digital tools (building a project) - Financial difficulties	- Teachers' wish for a turnkey project proposal, - Difficulties to convince schools of the benefits of DT

CONCLUSION

This research work described how a study on teachers' representations was shaped using GTM. The paper only dealt with the first work-package of a three-phase research study, which explored eight teachers and eight teaching advisors' discourse on DT in the French Polynesian elementary school context. GTM aims to generate theory through systematic analysis. However, this first work-package used this approach merely as a comprehensive data analysis method. The ideas, themes, categories emerged from the data illustrated the existence of prominent and thick groups of representations that included other lower level abstractions which pointed to variations due to different experiences. This study is still in progress, and the phenomena under investigation have not yet fully explored. In the coming work-packages, the researchers intend to enhance maximum variation through the inclusion of inspectors and trainee teachers. In the final work-package, the researchers will analyse the video-recorded lessons they collected from five different French Polynesian archipelagos. The analysis of these video recorded-data will focus on the examination of the use and non-use of digital tools, types of digital tools used in teaching, classroom interaction and organization types, and approaches used in classroom practices.

The teachers' statements indicated that DT was not being used in its highest capacity and even much less in the classroom with the students. The results suggest that all interviewed teachers were familiar with and used DT regularly to answer emails, communicate on social networks, and to prepare their lesson. However, only half of the participants stated that they used digital tools with their students in the classroom: (i) on a regular basis (n=3) and (ii) sometimes, with some specific activities (n=5). The other eight teachers stated that they used a digital tool (i) one time (n=5) and (ii) never (n=1). The data, indicated that there was a gap between the teachers' use of digital tools for personal purposes (e.g., such as email and other social networking) (n=16) and their professional use outside of class time (e.g., to prepare their lessons) (n=16) and the learners' active use of technological tools in class (n=8). Our findings bear similarities with other research studies conducted on the topic (Cuban et al., 2001; Ertmer & Ottenbreit-Leftwich, 2010; Palak & Walls, 2009; Prestridge, 2012; Russell, Bebell, O'Dwyer, & O'Connor, 2003). Thirty-six percent of the coded statements expressed positive feelings about DT, and sixty-four percent of the statements expressed problems. However, no teacher expressed any direct refusal or rejection concerning the adoption and integration of DT for educational purposes. Although sixty-four percent of the coded statements expressed problems, all these negative arguments were in the form of explanations, and justifications for non-use. Relevant literature provides us with similar findings in other studies (Cottier et al., 2015; Ferrière, Cottier, Lacroix, Lainé, & Pulido, 2013).

The teachers' statements revealed a balance between the female and male participants' use of DT tools in the classroom: four female and four male participants stated that they used DT in their classrooms (5 occasionally & 3 regularly); three female participants and four male participants stated that they used digital tools once or a few times with their students. One female participant revealed that she never used any digital tools in her classes. Concerning DT and gender issues, relevant literature has implied greater investment and knowledge from male participants compared to female participants (Cros, 1997; Ferrière et al., 2013). The analysis of the teachers'

statements did not suggest differences between the teachers' gender, age, years of experience and their representations concerning DT.

Discussion & Implications

The results obtained from this study bear similarities with other research studies done in diverse educational settings (Ely, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, et al., 2012; Prestridge, 2012). All in all, the teachers' arguments were mainly linked to both internal (personal) and external (other related) factors.

Research results concerning non-use of DT indicated that:

(1) internal factors such as personal interest in technology and positive representations regarding its use and perceived self-efficacy in technical skills and pedagogical competencies (see Ely, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, et al., 2012; Prestridge, 2012); and

(2) external factors such as support from administrators, suitability of the teacher training programmes offered, availability of technical assistance and regular maintenance played key roles in shaping the teachers' DT practices. Prestridge's study also highlights the influence of external factors on teachers' representations and practices (Prestridge, 2012).

The results obtained from this study suggest that prior to the design of any DT training programme the following should be carefully considered:

(1) The teachers' representations about their skills and their needs and their attitudes toward the DT practices.

(2) Availability of technical assistance and updated digital tools corresponding to the teachers' pedagogical needs.

(3) Concordance with the available digital tools and the content of the training programme provided.

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