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Looking for Cracks in the Pavement: Maltese Teachers' Temporal Adaptation Patterns Toward Tablet PC Use in Formal Educational Settings

Patrick Camilleri
University of Malta

This paper examines adaptation processes a group of Maltese teachers employed to contextualize tablet PC use in formal educational contexts. Research in information systems stipulates that while time may play an important role in technology, timing for accommodation and adaptation still represents a gray area that requires more attention. Nascent data indicates that over a relatively short period of time, intense but voluntary exposure to tablet PCs triggered attitudinal adjustment processes that catered for accommodation and adaptation toward the technology. The sharing of experiences, technology mediations, and recursive and contextualized dialogues between players seem to have been important in accelerating sense-making adaptation processes, consolidating newly formed technological interpretations.

Presently she directed the chair to the wall and pressed an unfamiliar button. The wall swung apart slowly. Through the opening she saw a tunnel that curved slightly so that its goal was not visible .... She shrunk back into the room, and the wall closed up again. (Forster, 1982, p. 133)

Suggestive rapid emerging scenarios and repercussions of a booming digitally mediated reality were neatly attributed for when Palfrey and Gasser (2008) stated, "Despite the saturation of the digital technologies in many cultures, no generation has yet lived from cradle to grave in the digital era" (p. 3). Yet, within fast changing digitally mediated scenarios, the introduction of a new technology generates multitudes of responses and interpretations (Griffith, 1999). Unequivocally, therefore, the achievement of equilibrium between the structural qualities of the technology and users' social mediations is a complex issue. In the meantime, many governments all over the world boast of strong standing digital agendas in formal education settings (Selwyn & Facer, 2013). Recent meta-analytical reviews on one-to-one (1:1) laptop integration programs, such as those compiled by Harper and Milman (2016) and Zheng, Warschauer, Lin, and Chang (2016), however, have portrayed a mix of successful outcomes, not the least dependent on the ways targeted groups (in this case educators and students) contextualize digital technologies in formal educational contexts.

An overview of discourse in technology acceptance models portrays an assortment of positions. While Positivist interpretational paradigms tend to use hardware and instructional technology innovation as a predictor for success (Lauterbach & Mueller, 2014; Lucas, Swanson, & Zmud, 2008), Constructivist models portray and stipulate a direct link between users' motivational use and implementation outcomes.

Seen as the outcomes of recursive dialogues between users' interpretations and technology properties if change is triggered by an implemented technology, then it is manifested as social action (Orlikowski & Scott, 2009). Lauterbach and Mueller (2014) stated, however, that many implementation projects never realize their intended benefits. They fail to deliver either before rollout or else gradually flicker off after going live. This result can be attributed to issues related to organizational or individual resistance during the adoption processes of the new technology by its targeted users.

A technology is unlikely to work well from its initial inception. Rather, the ways users employ technology in situ and the full understanding about how such accommodations to technologies take place will likely result in better technology implementation (Tyre & Orlikowski, 1994; Van de Ven 1986). In this case, the principle of technology-in-use as an initiator and conceptual vehicle for processes of technological adaptation processes stipulates that subsequent evaluation of attitudinal changes and perceptions to technology will play a central role for structuring arguments on what Tyre and Orlikowski (1994) referred to as temporal windows of opportunities.

Accordingly, motivations underlying this research are represented in a process form of approach (Orlikowski, 1996; Tyre & Orlikowski, 1994). Subsequently, four questions directed toward evaluating user adaptation, manifested by changes in skills, working knowledge, beliefs, attitudes, and aspirations were set:

1. Walsh (1995) asserted that, once formed, frames are resistant to change. On the other hand Davidson (2002) claimed that contextual change can reconfigure frames. Therefore does the presence of a technology, use, and gained experience bring about change in users' perceptions and interpretations toward the named technology?
2. According to research in social psychology (Bandura, 2002) and the constructivist approach, schemas and technological frames are shared among individuals (Fiol, 1994; Gioia, Donnellon, & Sims, 1989; Olesen, 2014; Porac, Thomas, & Baden-Fuller, 1989). Thus, if modifications in technological frames occur, are they the result of reflection and innate spontaneous enactment or the outcomes of collaborative initiatives?

3. There is substantial research that proposes the importance of recursive processes and mutual adaptation of users and technologies in question (Leonard-Barton, 1988; Orlikowski, 2000; Orlikowski & Gash, 1994). In this case does the inclusion of a new technology necessitate other organizational changes?
4. By inclining toward adaptive structuration theory, can it be suggested that as an outcome of technology-in-use, the material and the human agency are, therefore "... constitutively entangled in everyday life" (Orlikowski & Scott, 2009, p. 463), and one cannot be separated from the other? Simply said, is necessity the mother of invention?

Consequently, this paper portrays a case study established around a national implementation program in Malta that foresaw the introduction of tablet PCs (TPCs) to all Year 4 primary school children, their respective teachers, and learning support assistants. Specifically, this study focuses on time-related changes in technological frames and technology adaptation processes that preceded the full-fledged implementation process.

It considers a pilot group of volunteering teachers indicated by the local education authorities who had the task of familiarizing with the TPCs in context of their own classroom reality. Subsequently, through the application of an analytical lens based on Technological Frames of Reference (TFR), observed changes in individual and shared practices toward the technology in question were evaluated and interpreted.

The paper is, therefore, organized as follows. With Technological Frames at its core, an overview of literature that considers time as the nexus in technology adaptations and changing perceptions is first provided. Second, a description of the context within which research was carried is furnished. Next is an illustration of the methodology adapted to define and evaluate the nascent patterns of perceptions of the technology. Finally, as a conclusion, an interpretation of data, study limitations, and suggested follow-up are given.

Theoretical Foundation: Adaptations Toward Technologies

The purpose of Technological Frames as proposed by Orlikowski and Gash (1994) is to understand technology use in organizations. It is an approach best outlined as

> that subset of members' organizational frames that concern the assumptions, expectations, and knowledge they use to understand technology in organizations. This includes not only the nature and role of the technology itself, but the specific conditions, applications and consequences of that technology in particular contexts. (p. 178)

The central tenet, therefore, stipulates that in the case of an implemented technology individuals tend to draw upon tacit and familiar cognitive structures or schemas (Bandura, 2002; Bartlett & Burt, 1933; Neisser, 1967), which in some way or another relate to what is being presented. These, conceptual developments, or schemas, give rise to notions of sensemaking as ways of relating to and making sense of actions and processes in organizations (Gioia & Chittipeddi, 1991; Gioia & Mehra, 1996; Gioia & Thomas, 1996; Thomas, Clark, & Gioia, 1993; Weick, 1980, 1995; Weick, Sutcliffe, & Obstfeld, 2005).

Gioia (1996) stated that frames include "assumptions, knowledge and expectations, expressed symbolically through language, visual images, metaphors and stories" (p. 50). Technological Frames are, therefore, considered to take shape from the principle that, independent of facts and objectivity reality, people tend to subjectively filter information and construct their own reality, based on schemas.

Assumed as reality and fact, frames are, therefore, the constructed and shared notions (Davidson, 2002; Orlikowski & Baroudi, 2002) that people employ to understand and give meaning to their surroundings. Weick (1990) stated that "cognition and micro-level processes are keys to understanding the organizational impact of new technologies" (p. 17).

Technological Frames operate discreetly in the background, and as they become the accepted way of understanding subjective human interpretation, they subtly influence outcomes at macro-organizational levels (Orlikowski & Gash, 1994). Therefore, examining traits and taken-for-granted assumptions that people intuitively develop around a technology at the micro-level (Orlikowski, 2000) can provide insights toward the outcomes of that particular technology, either before going live or as a source of insightful readjustment after implementation.

Since 1994, the research stream on technological frames has been enriched with several studies, such as those conducted by Chang (2008); Davidson (2000); Mengesha (2008); Mishra & Agarwal (2010); Puri (2006); Sobreperez (2008). Despite the applied nuances to Technological Frames, three major domains of categorization for Technological Frames, as originally defined by Orlikowski and Gash (1994), still hold and include technology-in-use, technology strategy, and technology nature (Olesen, 2014). These domains tend to be related.

Of particular interest for this study has been the principle for technology-in-use, as it defines perceptions that are liable to evolve with experience and reflection from use (Davidson, 2002). As Tyre and Orlikowski (1994) stated, time is a very important ingredient for the formulation and the reformulation of frames. Even here, however, disagreements arise, as will be explained.

At the core of technological frames lie the recursive actions of structuration (Giddens, 2004; Orlikowski & Gash, 1994). When adopted into the discourse of adaptive structuration they can be employed to interpret the way designed qualities of a technology can merge into social structures to surface with contextualized and appropriate new sets of rules (DeSanctis & Poole 1994; Orlikowski & Yates, 1994). Substantial research in information systems (IS) analysis links hands-on experiences to successful technological adaptation, where nascent enactments give rise to innovations that go beyond original implementation goals (Rice & Rogers, 1980).

Tyre and Orlikowski (1994) pointed toward a well-defined ideological rift that converges to timings for adaptation. On one side is the innovation stream, which treats adaptation as a relatively continuous and incremental adjustment process leading toward the internalization and contextualization (even naturalization) of a technology process. On the other side is the behavioural approach, which emphasizes discontinuous and uneven patterns of adaptation and modification.

Beaudry and Pinsonneault (2004) stated that in all likelihood the provided information on the technology event is not be homogenously spread in the population. Further, they said that the processed information is often subject to personal appraisals and constructs, even interpreted oppositely, being seen as an opportunity by one and a threat by another (Folkman, 1992; Lazarus & Folkman, 1984, as cited in Beaudry & Pinsonneault, 2005; Stone, Kennedy-Moore, Newman, Greenberg, & Neale, 1992). Subsequently, as the adaptation process is influenced by specific personality traits (Griffith, 1999) it can also be triggered at different times during any part of the implementation process: that is, as from the inception of the idea to the time that the technology goes live. Thus, while adaptation processes may not yet be well understood and, therefore, require more attention, they can be envisaged as erratically patterned practices, at times evolving gradually while in other

instances discontinuously (Majchrzak, Rice, Malhotra, King, & Ba, 2000). In the meantime, relatively brief windows of opportunity arise before routinization of use entrenches attitudes and reduces chances for modification (Orlikowski & Gash, 1994).

Context and Research Approach

In Malta, the possibility that the same structural qualities defining a technology can create its own indispensability (Castells, 2000) has been mirrored by strong, ICT reliant economy strategies (Camilleri, 1994; Digital Malta, 2014; Malta Council of Science and Technology, 1992; Ministry of Information Technology & Investment [MIT&I], 2004, 2008), not the least envisioned and supported by specifically designed eLearning strategies (MIT&I, 2006; MIT&I/Ministry of Education Youth and Employment, 2008) and changes in the Maltese National Curriculum Framework (The Ministry for Education and Employment [MEDE], 2012).

The program for information and communications technology (ICT) inclusion in Malta's schools has been long and ongoing. The enhancement of digitally mediated learning has been typified through the introduction of various classroom technologies, procurement of laptops to all teachers and learning support assistants (LSAs) and the roll out of several Virtual Learning Environments and Learning Management Systems in state and nonstate schools (Curmi, 2015). In March 2014, a national pilot project was implemented, envisioned as a feedback exercise and support toward the introduction of TPCs to teachers and LSAs of all Year 4 children in Malta. Highlighted as a major educational endeavour (Government Gazette, 2014), it can be described as a living lab whose outcomes were designated to provide guidance for implementation purposes later on in 2016.

As exemplified in the Figure 1, the national pilot project ran over two phases, between March 2014 and March 2015. It comprised the participation of 22 primary state, church**,** and independent schools, and a school for students with special needs (Times of Malta, 2014).

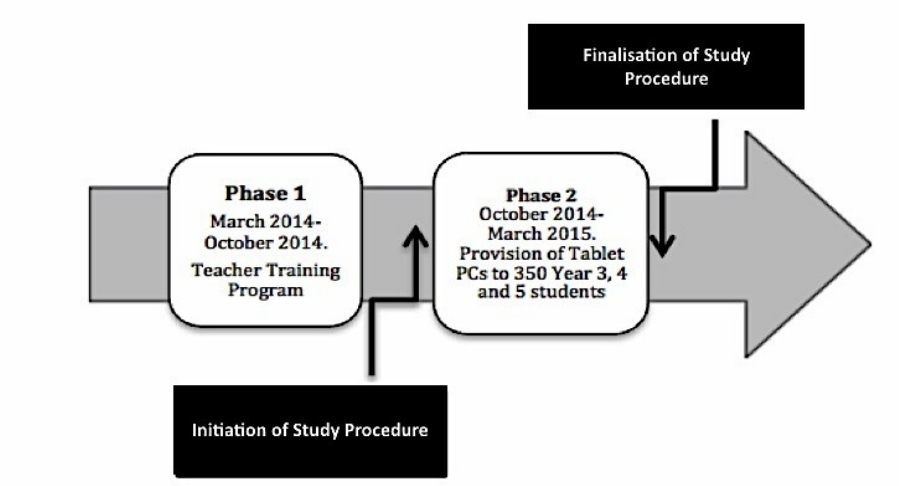

Figure 1. *Timeframe for research program.*

In all, 350 primary school children and 31 primary school teachers were involved. Phase 1 of the national pilot project initiated in March 2014 with induction exercises and training

for the teachers chosen from a volunteering group. In Phase 2, between October 2014 and March 2015 (the time during which this research was implemented), both teachers and all pupils involved were supplied with an Android-, an iOS- or aWindows-based TPC.

Methodology

With the premise that reality is a human construct and, therefore, biased toward subjective interpretation, interviewing was chosen as the best option for this research. In this case the methodological approach was qualitative and designated to elucidate changes in technological frames that teachers taking part in this research exercise embraced with respect to TPCs. Holstein and Gubrium (2005) argued that the relation between perception and its objects is not passive. Rather, than being a standalone or in a vacuum, it is a recursive and constitutive part of the perceived world (Berger & Luckmann, 1967).

Research procedures commenced after I applied and gained ethical clearance. This included the permission for me (author and researcher) to visit and interview the teachers involved. Before the actual deployment of the research procedure, the piloting and editing of the research tool was performed on two different instances in summer 2014. Subsequently, the finalized interviewing tool was implemented a month after the beginning of the scholastic year during October 2014 and then near the end of national pilot project, in March 2015.

I conducted all interviews. Incidentally, my relationship with the teachers in this study was solely based on the fact that I fostered interest in their changing Technological Frames.

In all, 20 teachers were individually interviewed face to face. Two interview exercises were employed with each of the teacher participants, so a total of 40 interviews were conducted. The first set of 20 interviews during October 2014 marked the initiation of the research exercise. The second set of 20 interviews during March 2015 (with the same 20 teachers) marked the end of the research exercise.

Interview duration ran from 90 to 150 minutes depending on the interviewee. All interviews were conducted at the school where each teacher was employed during school hours. Interviews were based upon 29 indicative questions that varied in structure and quantity, according to the way the interviewee chose to reply. All interviews were recorded with prior written and signed consent from the interviewees.

Description of the Analytical Tool

The analytical tool employed was descriptive and deductive:

1. Descriptive, because through the application of a theoretical framework based on Technological Frames, it was designed and intended to describe and analyze overall teachers' changing perceptions toward TPC use in class.
2. Deductive, as in the case of Tyre and Orlikowski (1994), where Technological Frames of Reference (as the theoretical lens) was applied to investigate further the presence of a relation between time and teachers' changing perceptions toward the TPC.

Structurally, the interview included both closed and open-ended questions. Closed format questions (Oppenheim, 2001) offered a definite answer from an expected amount of alternatives, or simply a "yes" or a "no." More open-ended or free-response questions

allowed further grounds for deliberation and dialogue. Therefore, the philosophy underlying the interview and the eventual examination style relied on a form of content analysis, where the emergence of data dictated the setting of the analytical parameters.

Both sets of interviews were loosely categorized in two groups before and after the pilot implementation exercise. All recorded interviews were then analyzed. Suggestive words, phrases, and sentences were transcribed such that nascent data made allowance for the setting of defining themes or domains of categorization to be set in each group.

As illustrated in Figure 2, all data in each domain were reexamined and recoded for a more granular analysis by using the dimensions adopted from the Technology Acceptance Model (TAM). Suggestive of shifting Technological Frames and, therefore, adaptations to technology-in-use, I employed subdomain variables that could particularly gauge specific adaptation patterns and compare how they changed over time were. They are exemplified as Behavioural Intentions (BI), Perceived Usefulness (PU) and Perceived Ease Of Use (PEU; as in Davis, 1985).

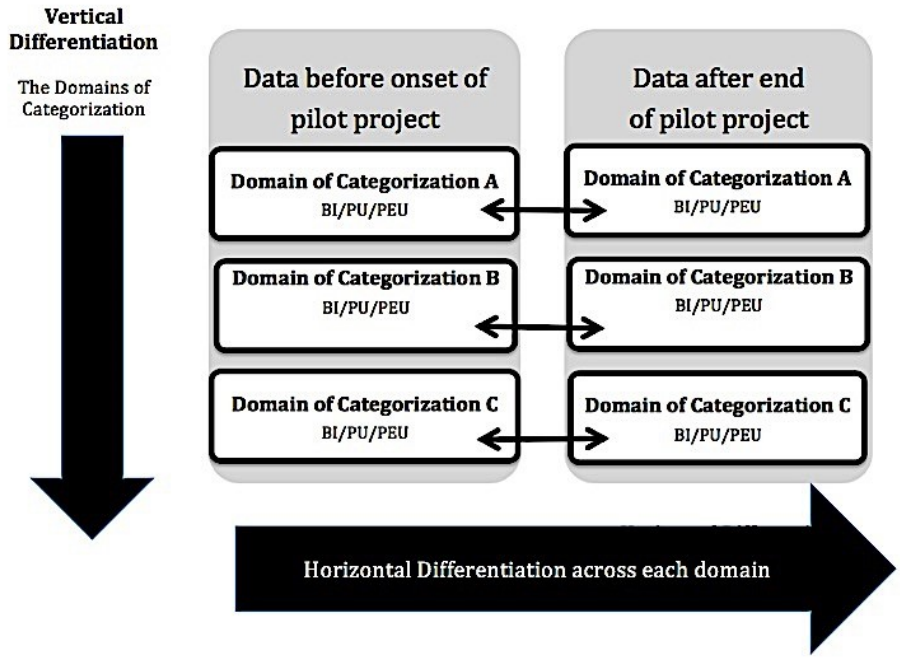

Figure 2. *Instrument structure: Domains and subdomain variables.*

The Domains of Categorization

Orlikowski and Gash (1992) stated that "frames are likely to be time- and context-dependent, and always more valid when examined in situ rather" (p. 184) than when they are assumed beforehand. Thus, specifically for this research and in line with emergent themes, three domains of categorization were employed:

- Domain A: The Sentiment toward the Technology

- Domain B: Strategy and Personal Insights for Initiation
- Domain C: Technology-in-Practice.

Domain A: The Sentiment Toward the Technology. In this domain of categorization, assumptions, opinions, and reflections the respondents embraced with respect to digital technologies, particularly TPCs, were considered. "An important aspect of using technology is to know about it and manipulate it effectively" (Orlikowski & Gash, 1994, p. 188). Social constructivists such as Sewell (1992) and Bijker, Hughes, and Pinch (1989) said that embedded structures on a technology "underlie and generate practices" (Sewell, 1992, p. 22).

Initially the employable characteristics of a technology will be those attributed to the functional qualities given by the designer. Once employed, they are also exemplified through human action in what Orlikowski (2000) defined as emergent structures, or technology-in-practice.

Emergent sentiments were not seen in isolation but in context of the respondents' personal and professional spheres. An important characteristic in Technological Frames is that of cognitive alignment (Orlikowski & Gash, 1994). Orlikowski and Gash employed the principles of cognitive alignment between different groups of people to gauge differences in technological frames. In this case it was deemed interesting to see how habitual use of the technology in the personal and professional sphere for the same group would have changed during the period the TPCs pilot project was live.

Domain B: Issues of Reflection on Initiation and Strategy. In context of several Maltese ICT-related national policies and initiatives to integrate more ICT in formal educational settings, this domain of categorization tested how much respondents were capable of linking the importance of their feedback to the national agenda. Sedlack and Tejay (2011) stated that the way a technology "should be used and why it was implemented in organizations" (p. 154) is at the roots of its success.

Like any other technology implementation, bringing computer devices in schools is not as challenging as the actual classroom practice. Reich and Daccord (2015), founders of the professional firm EdTechTeacher, noted that the upward surge to introduce tablets in the classroom is not being accompanied by a corresponding surge to connect them to learning goals.

In what she defined as a policy-instilled/practice problem, Livingstone (2012) stated that the demands underlying effective use of ICT in formal educational contexts outshine those of implementation. Actually, "the investment in hardware has yet to show noticeable benefit in educational practices" (p. 6). Thus, assessing the importance participants sensed in the task they had volunteered for would eventually impact on the nature of feedback they would give to the central administration and the best way forward in the implementation process.

Domain C: Technology-in-Practice. This domain evaluated modifications in motivation through reflection acquired from use. As in the case of Domain A (The Sentiment Toward the Technology), a cognitive alignment exercise was implemented by comparing analyzed resident interpretational traits to nascent ones that may have developed after users availed themselves of the TPCs during the life of the project.

Through technology-in-practice, Orlikowski (2000) acknowledged that during recurrent practices with a technology, people are able to enact new forms of structures that give rise

to other ways in which the same technology could be used. Distinctions are made between the technology as the artefact and its human interpretation and between appropriation and enacted new activities. Therefore, in this domain, changing attitudes and motivations that the respondents may have developed and articulated with respect TPCs than those already appropriated from the embedded qualities, were tested. Ultimately, temporal adaptation patterns were traced through distinctions between appropriations, induced behaviour at the initiation of the pilot study, and nascent enacted attitudes as exemplified through levels of customization, creativity, and levels satisfaction at the end.

The Subdomain Variables

An extra component to the analytical tool included the addition of three subdomain variables that ran with time across each domain of categorization. The adopted and adapted subdomain variables (Davis, 1985) provided an added layer of granularity to the analytical tool as shown in Table 1:

Table 1
The Subdomain Variables

Subdomain Variable	Definition
Changes in Behavioural Intentions (BI)	Modifications in underlying intentions toward adoption of the technology. Determination of creativity in use thus analysis of resident and novel enacted forms of utilisation of TPCs
Changes in Perceived Usefulness (PU)	Evaluation of beliefs that TPCs bring enhancement in teaching and learning methodologies.
Changes in Perceived Ease of Use (PEU)	Modifications in perceived efforts and intention to use the technology upon reflection through experience gained from their employment.

Description and Interpretation of Data

Data were sequentially processed through the three consecutive stages of Description, Analysis, and Interpretation (DAI) model adopted from Wolcott (1994). In the Description phase, emergent data were treated as fact and, therefore, recorded through long excerpts of respondents' reactions and replies. This phase was followed by the Analysis phase, where indicative excerpts derived from the interviews in the Description phase were classified into nascent Domains of Categorization . Analysis converged on particular emergent traits that were further classified and evaluated through the subdomain variables. Finally, in the Interpretation stage, perceived associations and time-dependent trends were processed and interpreted with Technological Frames as the core theoretical lens.

As illustrated in Figure 3, this approach provided grounds for a cognitive alignment exercise set to differentiate between time-dependent contextualized perceptions toward TPCs that were taken as indicative of adaptation processes.

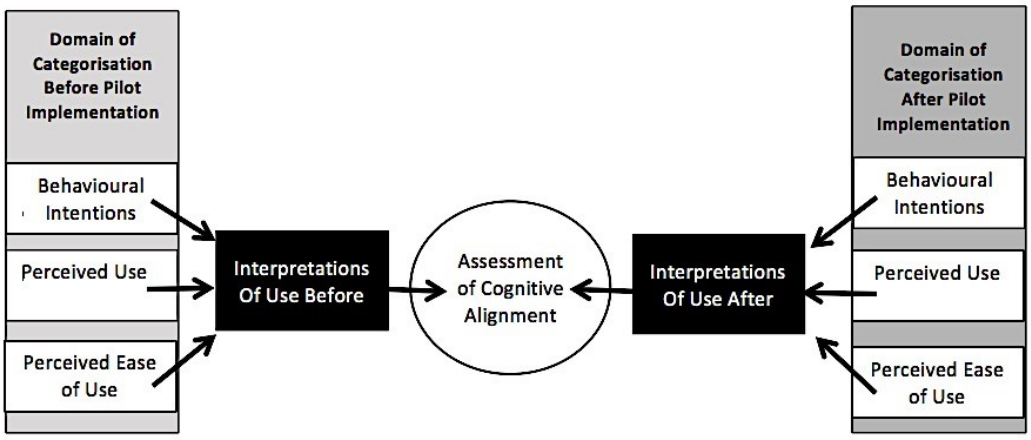

Figure 3. *The analytical process.*

Synopsis of Results

Thirty-one teachers coming from 22 different localities of the Maltese islands were involved in the pilot project. Teachers from four localities did not reply to the call for the interviews. Out of the 31 teachers involved, nine did not reply, while two were unavailable either for one or both interviewing calls. They were automatically excluded from the research.

From the 20 eligible interviews, 15 interviewees were teaching classes that included pupils utilizing TPCs. Five, described as reserve teachers who would substitute for any of the other teachers who might withdraw, taught classes with children who did not have the availability of a TPC in class. Of 20 interviewed participants, 19 were females and one was a male. Therefore, as Gender could not be considered as significant, the variable was also excluded from the analytical tool so as not to individualize the male respondent from the population. In this case, irrelevant of gender, all respondents were denoted with the same alpha numeric code using R (for respondents) followed by a number per respondent, thus R1, R2, to R20 in no specific order.

Age groups for interviewees were set as follows: Four were ages 20-29, 7 were ages 30-39, and 9 were 40 or older. Except for one participant who taught in a school with special needs, all respondents taught Year 4 and 5 pupils ranging in age between 7 and 9 years. Teaching experience in the group was as follows: Two had 0-5 years of experience, eight had 6-10 years, and 10 had 10 or more years.

Outcomes from Domain A: The Sentiment Toward the Technology. With the exception of one, all of the respondents projected a positive outlook toward digital technologies, associating them with progress. Most mentioned that it was a life changer, making life easier but at times more complicated:

- "With readily accessible Internet and more sophisticated smartphones, we end up being constantly available and, therefore, working all the time." (R4)
- "To be really alone or alone with my family, I have to switch off everything." (R7)
- "Social media like Facebook is taking away the human touch." (R11)

Of interest was the change in perception for a reserve teacher in the second interview. As a reserve teacher it had been made clear beforehand that the students were not to be supplied with a TPC. This requirement seems to have disturbed her to the extent of stating,

> Now that my students have not been supplied with TPCs, like in the case of my colleague, I can claim to have been able to work without them well. I can say that I have outgrown myself and realized that, notwithstanding all the noise associated with digital technologies and what they can do for learning, we are forgetting how good we were without them. (R5)

Nineteen attributed digital technologies to hardware like computers and handheld devices. In the first interview, two respondents related digital technologies to the interactive whiteboard (IWB) as part of the equipment available in class. All perceived digital technologies as indispensable in their personal sphere, but none took a similar stance for the same technologies in educational contexts. During the first interview five considered digital technologies as useful in educational contexts but did not directly relate them to their personal experiences in class.

In the second interview and at the end of the pilot initiative, a shift in projected Behavioural Intentions (BI) was observed. From experience gained in the pilot project, eight teachers, out of which two happened to be reserve teachers, projected more concrete PEU and, therefore, clearer BI on what they did could do with the technology in their class and in educational contexts:

- "TPCs can be utilized for literacy exercises and to work in groups." (R12)
- "From what I have seen when using the TPCs in class, I think they can enhance collaboration." (R8)

Three were convinced that, if used creatively, such technologies can in all certainty take learning to a "different" (not higher or better) level.

Participants' manifested ease of use for digitally mediated processes remained unchanged in both interviews. Most had regularly purchased services and other merchandise from online sources. All had a smartphone and, except two, their own personal TPC. All those who had a personal TPC expressed ease in interchanging activities between their TPC and mobile phone. While interviewees manifested strong naturalization qualities toward TPCs, 19 of those having a TPC preferred the use of a keyboard to typing directly on the screen, with no intention of changing their attitude in the near future.

When it came to reading, either from the book or the screen, a notable shift toward reading from the screen or to using both was observed from the initiation to the end of the piloting exercise (Table 2). No relative change in trend or relation could be attributed to being a Reserve teacher or not.

Table 2
Reading Preferences

	Before	**After**
Books	17	9
Screen	2	6
Both	1	5

Outcomes from Domain B: Issues of Reflection on Initiation and Strategy. All participants except R12 were positive in taking the step forward to volunteer. Except for R12, who seemed to be unsure on how to now proceed, all of them saw it as challenge. In the first interview R12's PEU of the TPC was very low, to the extent of contemplating resignation. Then again, R12 was concerned how the withdrawal from the project might have had negative repercussions on her professional status within the school, peers, and the authorities concerned.

> I should never have volunteered. I was given some training on how to best make use of it, but I feel so unprepared.... I am very much concerned on what the department of Education might think if I were to resign. (R12)

Incidentally during the second interview there was a marked change in R12's attitude. Visibly more confident, she admitted that having placed substantial effort with the help of the school's ICT teacher and slowly finding her own path to use it in class had allowed her (albeit cautiously) to venture beyond her limitations. Besides using and employing the TPC in ways she had been coached to do, her PEU had been bolstered. She now claimed she was slowly testing new approaches, such as technology-enhanced group learning, and implementing communities of practice where children were helping each other to use the TPC in the class.

> Initially, I thought it was a mistake and should have never gone for it.... I had to find my own path in using TPCs to teach and from which I have learned a lot. I am observing that teachers who have not yet made use of the tablet have a low opinion about the tablet and take it as a waste of time. It was the same for me. Now, I think otherwise because having it constantly available allowed me to see how I could plan my time better around it. (R12)

During the first interview none of the teachers took volunteering as something from which policy makers and implementers could benefit. Rather they visualized it as a means of enhancing their own personal professional output or as an extension of other similar initiatives they had participated in before.

Rather than recognizing the TPC initiative as a coercive effort to enhance a policy for implementation, replies focused on behavioural intentions that involved best motives for future use:

- "I volunteered because after seeing my children using it home I always wondered how I could possibly make best use of it myself at school" (R3).
- "It will prepare me for what is coming next, once it is introduced in class" (R18).

All participants claimed that the pilot project was a good initiative. In this case, 16 saw the relevance of participating in the national project as a personal enrichment:

- "I think that now being faced with the challenge of having to use the tablet in class will make me push my limits." (R12)
- "It is good. Since kids can use technologies with ease, now we teachers have the opportunity to learn and do the same." (R14)

Three attributed participation as a form of enhancing children's digital skills, either in formal educational contexts or as a mode for 21st-century education. Again, when asked why they decided to volunteer, only one of the respondents made any form of reference to

future perceived uses. “For kids it works miracles. So I wonder how and what if I can do the same for teaching the children in my class?” (R15).

During the second interview all, except R5 who expressed resentment for being a reserve teacher with no available TPCs for her students, showed a predisposition to embed arguments toward professional development in a wider context. Fifteen considered that now their enhanced perceived ease of use could be shared within the larger community:

- “From teachers to teachers, what better way?” (R7).
- “From what I have learned in these months with the tablet in class, my feedback is very important especially in choosing the right tablet.” (R9).
- “I do not take myself as a guru, but I learned a lot, so I assume that for the benefit of everyone they have to know what has come out of this.” (R10)
- “Yes. Hopefully, for once, teachers’ opinions will be acknowledged and the authorities will do as we suggest.” (R19).

In this case no significant differences were observed between groups as delineated by age, teaching experience. or (except for R5) in being a reserve teacher or not.

Outcomes from Domain C: Technology-in-Practice. No attitudinal divergences toward everyday practices of TPCs in schools were observed between those who owned a TPC beforehand and those who did not. All participants, except R5, believed that the introduction of TPCs in schools would be beneficial. During the first interview, 17 expressed positive but guarded opinions, two were looking forward to taking the plunge:

- “It is a learning experience from which I will definitely learn a lot.” (R4)
- “Better take the leap and learn like this than having it forced on me later on.” (R8)

In the first interviewing exercise, manifested BI toward the facilitation of innovative learning with the TPC was limited. Arguments mainly converged on the time required to translate set work to accommodate the use of the TPC. In a sense this finding shows that respondents were not seeing the TPC as a means of creating new learning experiences but rather as a means of transferring what they already had to the digital realm.

- “Rather than having it lumped on me, I am looking forward to learning from my own experience. But I am also anticipating long sleepless nights. I mean, how can I possibly transfer all my work exercises onto the tablet?” (R11)
- “These are really exciting times for me. Then again, I am very much preoccupied on how I can transfer my work on to the tablet. There is a lot that I have to learn yet. Thankfully, I can refer to the resident IT teacher.” (R12)

When asked about how they planned to use the TPC for learning, participants expressed vague PU, such as mentioning phrases of collaborative learning, online searching, and reading but with no further substantiation. Few replies considered the facilitative qualities of TPCs. One respondent (R9) referred to convergence where one device manifests the capability of hosting various activities through the use of multiple apps. Another participant suggested using the TPC for project-based learning activities, while two referred to using the TPCs in flipped classroom situations and to reduce isolation.

Setting up similar questions in the second interview rendered deeper insights, even to differentiating between conventional teaching modalities and novel digitally mediated

pedagogies: "In time, after I get a good feel of the situation I intend to experiment new things that I cannot do now, such as more student motivated learning and peer assessment" (R13).

Therefore, while maintaining a positive outlook toward the introduction of TPCs in the class, participants displayed enhanced contextualized working knowledge, individualizing potential pitfalls and setbacks better, manifesting concrete BI and PEU. It also became clear that a robust broadband service would be beneficial for TPC-facilitated activities, especially for more process inclined ones that relied on communities of practice, peer assessment, and learning.

- "Internet is an issue. I expect better connectivity. As soon as children go online the connection almost stops. I can only wonder what will happen once all the other classrooms have the tablets as well." (R7)
- "How am I supposed to organize children to work in groups? Once we try to go online the Internet becomes dead slow." (R12)
- "Hopefully, I will not have problems with the Internet." (R13)
- "I could make use of better connectivity so eventually students will access my iLearn." (R19)

There were many instances where an already overloaded syllabus was seen as an issue. Then again, the presence of TPCs allowed positive enhancements in PEU by better articulation of projected and anticipated work.

- "Pity that the syllabus is so vast. It does not make leeway to experience the richness of the technology." (R5)
- "Thinking on how to make best use of the tablet is time consuming. But other than planning on how to accommodate activities generated by the tablets, I do not think that the workload will increase. It will be different." (R8)
- "Workload will increase, obviously due to enhanced interest from the children." (R9)

In the second interview all participants disclosed a greater sense of confidence and ease of mind toward TPC use. No differences in attitudes could be attributed between being a reserve teacher or not.

I previously asserted that I should never have volunteered. Now I think otherwise. I am not saying that I am now a guru, but with the help of the IT teacher I think I am managing well and maybe I can help others who, like me, are not that familiar with technologies. (R12)

Discussion

Key Findings

The core component underlying this report rests upon the individualization and comparison of resident technological frames of reference a group of volunteering teachers embraced before and after using TPCs in the context of their classroom reality. Identified processes of adaptations and accommodations toward newly introduced technologies in formal educational contexts were reviewed through the domains of categorization leading to the formalization of four indicative key findings:

- Previous training on the use of TPCs helped to enhance users' skills, but it was not sufficient to reduce their concern on their output in class.
- Observed adaptations can be described as being dependent on personalized customization practices. The liberal use of the TPCs by the respondents contributed to nascent adaptations relying more on spontaneity than on resident innate knowledge.
- Resident self-centered technological frames at the beginning of the study evolved into perceived shared experiences.
- Adaptation and, ultimately, accommodation of new technologies were more susceptible to insights from contextually experienced individuals than prior was training.

Underlying Theoretical Interpretations

These findings are addressed in context of the posited research questions that directed this study initiative. Tyre and Orlikowski (1994) stated that, while discourse in technological innovation describes gradual and continuous processes of modification, behavioural theory is indicative of more discontinuous trends. Tyre and Orlikowski explained that 2 weeks is the time intended for a brief window of opportunity. However, the concept of length of time tends to be subjective.

For this research, considering contextual, innate and deep-seated routine teaching practices that the respondents tended to employ in their work, the 12-week period over which the pilot project was employed was, in fact, a window of opportunity that saw a rapid but steady upward change in users' perceptions of technology. The allowance of subjective and contextual free experimentation with the TPC by the teachers in the classroom paved the way to more confidence and eventual reconfiguring of related frames. The focus is to now discuss what circumstantial influences triggered such attitudinal modifications.

Mishra and Argwal (2010) distinguished between the mechanisms underlying the adoption of IT-based innovations and their actual assimilation. Ideally, after the adoption of a technology, processes that sustain further development and prohibit the initial drive from fizzling off should be triggered (Jasperson, Carter, & Zmud, 2005; Rai, Lang, & Welker, 2002).

In this study, sustainment resulted from user-generated enthusiasm that contributed toward an important twist to the fundamental meaning of sensemaking. Technology acceptance models tend to converge on a kind of sensemaking — here described as "retrospective sensemaking" — whereas people employ previous experiences to make sense of new circumstances they find themselves in (Weick et al., 2005).

Albeit a valid position, it is also inherently reductionist. It cannot explain how nascent trends or "technology-use mediation" processes (Orlikowski, Yates, Okamur, & Fujimoto, 1995) had instigated respondents (as decision makers) to facilitate and author their own adaptations. At this point, a significant distinction must be made between interpretations that respondents used to perceive and read the technology and their action that prioritized authoring and adaptation over reading (Bansler & Havn, 2006). Adaptation can be viewed as the result of personalized customization practices. These practices emerged from active recursive dialogues obtained from reflective contextual experiences and learning the respondents gained through opportunities of working with the technology in the classroom.

Incidentally, technology adaptation models tend to relate interpretations to the type of learning environment individuals are working in. In this case, no significant differences were observed between the cohorts of teachers whose pupils had a TPC in class and the reserve teacher group whose students did not.

Gal and Berente (2008) criticized prior frames studies that have used only interview data to elicit frames and neglected to consider how frames are formed and changed via social interactions. In this case, the aspect of shared schemas and technological frames contributed to the modification of frames. Organizational theory in information systems suggests that when the idea of individual "cognitive structures" (Orlikowski & Gash, 1994, p. 175) is extended into groups it evokes notions of shared meanings (Fiol, 1994; Gioia et al., 1989; Olesen, 2014; Porac et al., 1989).

Clearly, liaison between respondents from both cohorts helped a lot. Observed adaptations to TPCs were dependent on the outcomes of shared experiences in close-knit networks where participants in the same school were sharing and learning from each other:

- "I do not think that I could do it without the ICT teacher's help. She was always there for me." (R4)
- "I felt safe knowing that the ICT teacher would help me whenever I got stuck or the tablet stopped working." (R12)

Mackay (1990) referred to "translators" as those individuals who help others shape their own practices in technology. In this research some ICT teachers happened to be the translators who shared their expertise to help respondents achieve their goals. Yet, it was not always the case. In several instances, self-taught translators emerged, whose reconfigured technological frames and sensemaking allowed them to define their limitations and newly discovered needs.

As a side note, in the following comments it is interesting to see how the "I" was translated into "we," a clear indication that respondents were not seeing their experiences in isolation but as part of shared experience.

- "It was a good thing that I was allowed to experiment, work and learn at my own pace. What is a better way to learn if not by trial and error?" (R19)
- "We are always pressed for time. Initially, I was concerned that with the TPCs I will waste precious time. Now I look at things differently. I can say that I have found new ways where I can still manage to meet deadlines but including the tablet. Sadly, now that we have gotten used to it, we have to part with it." (R8)
- "I believe that the best way to teach teachers is for us to share our experiences with others fellow companions. What is a better way to learn if not from teachers to teachers?" (R6)

As a final note, according to adaptive structuration theory (Orlikowski & Scott, 2008) and principles in the Duality of Technology (Orlikowski, 1992), the constitutive entanglement of technology in everyday life gave rise to newfound necessities. These necessities include a more robust internet infrastructure that could sustain newly TPC-elicited practices, such as digitally mediated group works and peer assessment exercises. As these respondents carved out their own self-paced digitally mediated learning spaces, they were also motivated to modify their attitudes toward the use of the technology. This move plainly allowed them to venture beyond their comfort zones, causing shifts in their BI and PEU.

Conclusions

Implications for Teacher Training

On reimagining existing technologies in schools, Laurillard (2002) and Sharples (2003) referred to educational technologies as disruptive forces. In this case teachers must radically move away from traditional methodologies in preference to innovative ones. Alas, the disruption triggered by the ever-changing technologies is also causing teachers to be confronted by limitations of integration and use of technologies in context (Rawlins & Kehrwald, 2014). Outcomes from this study indicated that the free deployment and unhindered use of TPCs by the respondents prompted experimentation.

Unrestricted use also served to reduce limitations of integration, enhancing respondents' predisposition to the use of the device in context. Drayton, Falk, Stroud, Hobbs, and Hammerman (2010) observed that lack of sufficient professional development with technologies causes veteran teachers to experience steep learning curves that impact negatively on the outcomes of perceived contextualization. Nascent outcomes from this research stipulate that training methodologies empowering free and extensive personalized experimentation with technologies can potentially help learners cope with continuous change. This experimentation will enable novices in technology-enhanced learning to cultivate required educational scenarios that support alternatives to traditional teaching methods.

Employing disruption in a wider sense in this research, comparing respondents' sentiment through PEU in the first set of interviews to the second clearly demonstrated the change in the way the interviewees envisaged their position from a teacher in class to a member of a healthy learning community. Thus, if such forms of disruption are to be fostered to counteract the hurdles posed by perennially changing educational technologies, then the question educational trainers should ask will be, "What kind of social engagements provide the proper context for learning to take place?" (Even & Tirosh, 2002, p. 232). Accordingly, course design should focus on fostering communities of practice that, besides enhancing collaboration, will sustain the recursive dialogues between the individual learner and the social unit.

Another important aspect that emerged was the importance underlying personalization and accompanying authorship. Respondents placed a greater value on the TPC when they discovered things on their own. Designed in-service training prior to the initiation of the pilot exercise may have enhanced skills, but several respondents expressed concern on contextual implementations. This response is similar to what was observed in other studies (Harper & Milman, 2016). In this case teachers' concern about how to manage 1:1 laptop employment and lack of familiarity with contextual implementation led to trepidation (as also in Donovan, Hartley, & Strudler, 2007; Klieger, Ben-Hur, & Bar-Yossef, 2010).

Through the course of the research exercise, subdomain variable outcomes showed that respondents had come to foster concrete and more direct projections on how to employ TPCs in formal educational contexts. Growing belief and awareness that they were trusted to choose the way they wanted to employ the TPC gave the respondents a sense of ownership and pride, preserving enthusiasm.

Incidentally, Harper and Milman (2016) reported enhanced learners' engagement and motivation toward academic content during periods of 1:1 device usage. In this case while the interviewees were not students they were learners whose motivations would eventually influence their teaching outcomes:

- "With the tablet there is always something new to discover and try out." (R8)
- "Nothing gets boring now. Pity they have to take it away. I have got used this new sense of expectancy...wondering if things will go well or not." (R12)

The nature of support was seen to be another important ingredient. Notwithstanding the social affordances heralded through Web 2.0 and digitally mediated networks, all users expressed the need for more traditional and face-to-face support. Thus, the availability of technologists whose instructional contribution could work in tandem with the conceptual progress of teacher training courses is a must. Incidentally, as observed from the outcomes, the availability of translators with sound knowledge of the technology and pedagogical knowhow is imperative during course training, as they can bridge between context, content, and process, adding authenticity to the learning situation.

A Final Note and Study Limitations

Orlikowski and Gash (1994) considered that the active recursive dialogues that take place between the active users and the nascent structural qualities of technologies can ultimately shape the nature of the activity. Therefore, understanding the nature of that transformation is bound to be of great value for future implementations (Zheng et al., 2016).

Ironically, a potential limitation in the study has been one of the aspects that this research has been posited to consider, time. Tyre and Orlikowski (1994) made reference to a time frame of 2 weeks. However, they indicated a consequential instant whereby personal belongings they had stacked in boxes (as the technology) would be forgotten or, at mos,t ignored. "Indeed, several examples from outside of the studies ... suggest that the same patterns of behavior occur even in informal task settings without sophisticated process technologies" (p. 115). On the other hand, in this study, the situation involved gauging aptitudes toward a much more complex technology set in formal working contexts.

When Harper and Milman (2016) wrote about understanding processes that assess the influence of 1:1 technology (as in this particular case of TPC implementation with children), they referred to understanding change in learning environments and pedagogical practices based on teachers' instructional approaches and interactions. In another study examining Technological Frames, Camilleri (2012) asserted that technological frames are context-related, with crisp differences arising between the personal and professional spheres. Therefore, time-related frames can be different and context related. Subsequently, intermediate interview interventions separated by shorter time intervals may have resolved this ambiguity.

It would have been interesting to test the congealment or permanence of newly acquired technological frames. Albeit such validity, further interviewing interventions after the end of the project, could not be implemented.

Additionally, the principle of shared experiences and schemas in discourse on Technological Frames of reference (Davidson, 2002; Fiol, 1994; Gioia et al., 1989; Olesen, 2014; Orlikowski & Baroudi, 2002, Porac et al., 1989) as a major constituent for accepted frame modification (Orlikowski & Gash, 1994) is well manifested in this research. It can be an omnipresent trait that enhances technology adaptation phenomena and, therefore, should be researched further.

References

Bandura, A. (2002). Social foundations of thought and action. In D. Marks (Ed.), *The health psychology reader*. 6 (pp. 94-106). London, UK: Sage Publications.

Bansler, J.P., & Havn, E. (2006). Sensemaking in technology-use mediation: Adapting groupware technology in organizations. *Computer Supported Cooperative Work, 15*, 55-91.

Bartlett, F. C., & Burt, C. (1933). Remembering: A study in experimental and social psychology. *British Journal of Educational Psychology*, 187-192.

Beaudry, A., & Pinsonneault, A. (2005). Understanding user responses to information technology: A coping model of user adaptation. *MIS Quarterly, 29*(3), 493-524.

Berger, P. L, & Luckmann, T. (1967). *The social construction of reality. A treatise on the sociology of knowledge*. London, UK: Penguin Books.

Bijker, W.E., Hughes, T.P., & Pinch, T. (Eds). (1989). *The social construction of technological systems*. Cambridge, England: The MIT Press.

Camilleri, J. (1994). *Information technology in education. Business plan*. Malta: Office of the National strategy for Information Technology, University of Malta.

Camilleri, P. (2012). Teachers' interpretations of the internet. An applied case study for the evaluation of technological frames of reference. *Informatics in Education, 11*(2), 151-167.

Castells, M. (2000). *The rise of the network society* (2nd ed.). London, UK: Blackwell Publishing.

Chang, C.L. (2008, August). *Power operation in ISD: Technological frames perspectives*. Proceedings of the 14th Americas Conference on Information Systems, Paper 400.

Curmi, L. (2015). *Year 4 students' and teachers' perceptions on tablet use for learning. A comparative study*. Unpublished Bachelor of Education Dissertation. Faculty of Education, University of Malta.

Davis, F. D. (1985). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* (Doctoral dissertation, Massachusetts Institute of Technology). Retrieved from: http://dspace.mit.edu/handle/1721.1/15192

Davidson, E. (2000). Analyzing genre of organizational communication in clinical information systems. *Information Technology and People. 13*, 196- 209.

Davidson, E. (2002). Technology frames and framing: A socio-cognitive investigation of requirements determination. *MIS Quarterly*, *26*(4), 329-358.

DeSanctis, G., & Poole, M. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science*, *5*(2), 121-147.

Digital Malta. National Digital Strategy 2014-2020. (2014). Retrieved from https://digitalmalta.org.mt/en/Documents/Digital%20Malta%202014%20-%202020.pdf

Drayton, B., Falk, J. K., Stroud, R., Hobbs, K., & Hammerman, J. (2010). After installation: Ubiquitous computing and high school science in three experienced, high-technology schools. *Journal of Technology, Learning, and Assessment, 9*(3), 1-57.

Even, R., & Tirosh, D. (2002). Teacher knowledge and understanding of students' mathematical learning. In L. D. English (Ed.), *Handbook of international research in mathematics education* (pp. 219–240). Mahwah, NJ: Lawrence Erlbaum.

Fiol, C. (1994). Consensus, diversity, and learning in organizations. *Organization Science, 5*(3), 403-420.

Folkman, S. (1992). Making the case for coping. In B.N. Carpenter (Ed.), *Personal coping: Theory, research, and application* (pp. 31-46). Westport, CT: Praeger.

Forster, E. M. (2015). The machine stops. Sheba Blake Publishing. In D. R. Barnes & R. F. Egford (Eds.), *Twentieth century short stories*. London, UK: Thomas Nelson.

Gal, U., & Berente, N. (2008). A social representations perspective on information systems implementation: Rethinking the concept of "frames." *Information Technology & People, 21*(2), 133-154.

Giddens, A. (2004). *The constitution of society*. Oxford, UK: Polity Press.

Gioia, D. A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic Management Journal, 12*(6), 433-448.

Gioia, D., Donnellon, A., & Sims Jr., H. Jr. (1989). Communication and cognition in appraisal: A tale of two paradigms. *Organization Studies, 10*(4), 503-530.

Gioia, D. A., & Mehra, A. (1996). Sensemaking in organizations. *Academy of Management. The Academy of Management Review, 21*(4), 1226.

Gioia, D. A., & Thomas, J. B. (1996). Identity, image, and issue interpretation: Sensemaking during strategic change in academia. *Administrative Science Quarterly, 41*(3), 370-403.

Government Gazette. (2014, January 8). Tablets pilot project launched. *Government Gazette.* Retrieved from http://education.gov.mt/en/resources/News/Pages/News%20items/Tablets-Pilot-Project-launched.aspx

Griffith, T.L. (1999). Technology features as triggers for sensemaking. *Academy Management Review, 24*(3), 472-488.

Harper, B., & Milman, N B. (2016). One-to-one technology in k–12 classrooms: A review of the literature from 2004 through 2014. *Journal of Research on Technology in Education, 48*(2), 129-142.

Holstein, J.A., & Gubrium, J.F. (2005). Interpretive practice and social action. In N.K. Denzin & Y. L. Lincoln (Eds), *The SAGE handbook of qualitative research* (3rd ed.; pp. 483-505). London, UK: SAGE Publications.

Jasperson, J., Carter, P. E., & Zmud, R.W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. *MIS Quarterly, 29*(3), 525-557.

Klieger, A., Ben-Hur,Y., & Bar-Yossef, N. (2010). Integrating laptop computers into classrooms: Attitudes, needs and professional development of science teachers. A case study. *Journal of Science Education and Technology, 19*(2), 187-198.

Laurillard, D. (2002). *Rethinking university teaching: A conversational framework for effective use of learning technologies* (2nd ed.). London, UK: Routledge Falmer.

Laurillard, D., Oliver, M., Wasson, B., & Hoppe, U. (2009). Implementing technology-enhanced learning. In N. Balcheff, S. Ludvigsen, T. de Jong, A. Lzonder, & S. Barnes (Eds.), *Technology-enhanced learning. Principles and products.* New York, NY Springer-Verlag.

Lauterbach, J., & Mueller, B. (2014). Adopt, adapt, enact or use? In B. Doolin, E. Lamprou, N. Mitev, & L. Mc Leod (Eds.), *Information systems and global assemblages. (Re) Configuring actors, artefacts, organizations. Proceedings of the IFIP WG 8.2 Working Conference, IS&O 2014* (pp. 8-29). Berlin, GE: Springer.

Leonard-Barton, D. (1988). Implementation as mutual adaptation of technology and organization. *Research Policy, 17*(5), 1-17.

Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford Review of Education, 38*(1), 9-24.

Lucas, Jr, H. C., Swanson, E. B., & Zmud, R. (2008). Implementation, innovation, and related themes over the years in information systems research. *Journal of the Association for Information Systems, 8*(4), 8.

Mackay, W. (1990). Patterns of sharing customizable software. *Proceedings of the 1990 ACM conference on Computer-supported cooperative work* (pp. 209-221). New York, NY: ACM.

Majchrzak, A., Rice, R.E., Malhotra, A, King, N., & Ba, S. (2000). Technology adaptation: The case of a computer-supported inter-organizational virtual team. *MIS Quarterly, 24*(4), 569-600. Retrieved from http://ssrn.com/abstract=2537029

Malta Council of Science and Technology. (1992). *Vision 2000: Developing Malta as a regional hub through communications technology*. Valletta, Malta: Author.

Mengesha, N.T. (2008, August). The role of technological frames of stakeholders in IS development: A case study from Ethiopia. *Proceedings from IRIS 31 – The 31st Information Systems Research Seminar,* Scandinavia, Åre, Sweden.

Ministry for Education and Employment. (2012). *A national curriculum framework for all.* Retrieved from https://education.gov.mt/en/Documents/A%20National%20Curriculum%20Framework%20for%20All%20-%202012.pdf

Mishra, A N., & Agarwal, R. (2010). Technological frames, organizational capabilities, and IT use: An empirical procurement. *Information Systems Research*, *21*(2), 249-270.

Ministry of Information Technology and Investment. (2004). *The national ICT strategy 2004-2006*. Valletta, Malta: Author.

Ministry of Information Technology and Investment. (2006). *Requests for proposals. Development of an e-learning vision strategy and action plan for Malta*. Valletta, Malta: Author.

Ministry of Information Technology and Investment. (2008). *The smart island. The national ICT strategy for Malta 2008-2010*. Valletta, Malta: Author.

Ministry of Information Technology and Investment and Ministry of Education Youth and Employmen. (2008). *Smart learning. Malta's national e-Learning strategy 2008-2010. Embracing technology. Realising potential.* Valletta, Malta: Author.

National Curriculum Framework for All. (2012). Retrieved from http://curriculum.gov.mt/en/Resources/The-NCF/Documents/NCF.pdf

Neisser, U.,(1967). *Cognitive psychology*. New York, NY: Appleton-Century-Crofts.

Olesen, L. (2014). Technological frames: Use of context, temporality, and individual focus. *SAGE Open*, *4*(1), 2158244014526720.

Oppenheim, A.N. (2001). *Questionnaire design, interviewing and attitude measurement.* London, UK: Continuum.

Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, *3*(3), 398-427.

Orlikowski, W.J. (1996). Improvising organizational transformation over time: a situated change perspective. *Information Systems Research*, *7*(1), 63-92.

Orlikowski, W.J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, 11(4), 404-428.

Orlikowski, W.J., & Baroudi, J.J. (2002). Studying information technology in organizations: Research approaches and assumptions. In M.D. Myers (Ed.), *Qualitative Research in information systems: A reader* (pp. 51-77). London, UK: SAGE Publications.

Orlikowski, W.J., & Gash, D.C. (1994). Technological frames: Making sense of information technology in organizations. *ACM Transactions on Information Systems*, 12(2), 174–207.

Orlikowski, W. J., & Scott, S. V. (2009). 10 Sociomateriality: Challenging the Separation of technology, work and organization. *The Academy of Management Annals*, 2 (1), 433-474.

Orlikowski, W. J.. & Yates, J. (1994). Genre repertoire: The structuring of communicative in organizations. *Administrative Science Quarterly*, *39*(4), 541-574.

Orlikowski, W.J., Yates, J., Okamura, K., & Fujimoto, M. (1995). Shaping electronic communication: The metastructuring of technology in the context of use. *Organization Science*, *6*(4), 423-444.

Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives*. New York, NY: BASIC Books.

Porac, J., Thomas, H., & Baden-Fuller, C. (1989). Competitive groups as cognitive communities: The case of Scottish knitwear manufacturers. *Journal of Management Studies*, 26(4), 397-416.

Puri, S.K. (2006) Technological frames of stakeholders shaping the SDI implementation: A case study from India. *Information Technology for Development*, *12*, 311–331.

Rai, A., Lang, S. S., & Welker, R. B. (2002). Assessing the validity of IS success models: An empirical test and theoretical analysis. *Information Systems Research*, *13*(1), 50-69.

Rawlins, P., & Kehrwald, B. (2014). Integrating educational technologies into teacher education: A case study. *Innovations in Education and Teaching International*, 51(2), 207–217.

Reich, J., & Daccord, T. (2015). How to transform teaching with tablets. *Educational Leadership, 72*(8), 18-23. Retrieved from http://www.ascd.org/publications/educational leadership/may15/vol72/num08/How-to-Transform-Teaching-with-Tablets.aspx

Rice, R. E., & Rogers, E. M. (1980). Reinvention in the innovation process. *Knowledge*, 1(4), 499-514.

Sedlack, D. J., & Tejay, G. P. S. (2011). *Improving information security through technological frames of reference.* Proceedings of the Southern Association for Information Systems Conference, Atlanta, GA. Retrieved from http://aisel.aisnet.org/ sais2011/30/

Selwyn, N., & Facer, K. (2013). The need for a politics of education and technology. In N. Selwyn & K. Facer, (Eds.), *The politics of education and technology. Conflicts, controversies and connections*. Basingstoke, UK: Palgrave Macmillan.

Sewell, W.H. (1992). A theory of structure: Duality, agency, and transformation. *AJS*, *98*(1), 1-29.

Sharples, M. (2003). Disruptive devices: Mobile technology for conversational learning. *International Journal of Continuing Engineering Education and Lifelong Learning*, *12*(5/6), 504-520.

Sobreperez, P. (2008) Technological frame incongruence, diffusion and noncompliance. In G. Leon, A. Bernardoes, J. Casar, K. Kautz, & J. DeGross, (Eds.), *Open IT-based innovation: Moving towards cooperative IT transfer and knowledge diffusion* (pp. 179–196). Boston, MA: Springer.

Stone, A.A., Kennedy-Moore, E., Newman, M.G., Greenberg, M., & Neale, J.M. (1992). Conceptual and methodological issues in current coping assessments. In B.N. Carpenter

(Ed.), *Personal coping: Theory, research and application* (pp. 15-29). Westport, CT: Praeger.

Thomas, J. B., Clark, S. M., & Gioia, D. A. (1993). Strategic sensemaking and organizational performance: Linkages among scanning, interpretation, action, and outcomes. *Academy of Management Journal*, *36*(2), 239-270.

Times of Malta. (2014, March 16). Pilot tablet project will involve 22 classes. Retrieved from http://www.timesofmalta.com/articles/view/20140326/local/Pilot-tablet-project-will-involve-22-classes.512164

Tyre, M. J., & Orlikowski, W. J. (1994). Windows of opportunity: Temporal patterns of technological adaptation in organizations. *Organization Science*, *5*(1), 98-118.

Van de Ven, A.H. (1986). Central problems in management and innovation. *Management Science*, *32*, 590-607.

Walsh, J. (1995). Managerial and organizational cognition: Notes from a trip down memory lane. *Organization Science*, *6*(3), 280-321.

Weick, K.E. (1980). *The social psychology of organizing*. New York, NY: McGraw-Hill.

Weick, K.E. (1990). *Technology as an equivoque. Sensemaking in new technologies*. San Francisco, CA: Josey Bass.

Weick, K.E. (1995). *Sensemaking in organizations.* Thousand Oaks, CA: SAGE Publications, Inc.

Weick, K., Sutcliffe, K.M., & Obstfeld, D. (2005). Organizing and the process of sensemaking. *Organizational Science*, *16*(4), 409-421.

Wolcott, H. (1994). *Transforming qualitative data: Description, analysis, and interpretation*. Thousand Oaks, CA: Sage Publications.

Zheng, B., Warschauer, G., Lin, M. & Chang, C. (2016). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. *Review of Educational Research*, *86*(4), 1052-1084.

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