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Abstract: This paper aims to summarize the current changes in education concerning the use of innovative teaching methods and to understand the opinion on technology and its educational uses of both teachers and pupils. While pupils' grasp of their learning is a relatively underexplored field in educational research, it is paramount for effective lifelong learning. Our investigation focuses on the following aspects: the differences in the use of digital tools by the two groups, the motivations leading to certain uses and/or non-uses, the teachers' pedagogical perspectives and their views on how ICT can contribute to the learning environment, their considerations on the current situation. We used focus groups to explore the subjects' perspectives on innovative learning strategies, particularly ICT-based ones. In the final section, we consider future perspectives. Such assessments promote valid decision-making regarding to education and help in designing adequate learning experience to achieve effective learning objectives. Our findings point towards *learning through collaboration* and show that technologies can facilitate the learning process in cases of full participation by both teachers and students. The best learning environment, we discovered, is the one where teachers are no longer all-knowing controllers of activities but co-explorers together with the children.

Keywords: digital literacy, digital competence, innovative teaching methods, primary education, focus groups.

Introduction

Significant changes are today driven by informatization, robotics and artificial intelligence, also impacting education and learning strategies. The fields of youth education and training, as well as the school contexts, are strongly affected by these changes, as they impact on cognitive processes, habits, attitudes, ways of approaching reality of very young people. Since 2000, a vast literature has discussed the implication of a new generation of students (Prensky, 2001a, 2001b; Howe & Strauss, 2000; Oblinger & Oblinger, 2005; Tapscott, 1997, 2008; Veen & Vrakking, 2004; Lenhart, Rainie & Lewis., 2001; Pedrò, 2007; Gardner & Davis, 2014) – entering educational institutions. Most of these studies recognize an impact of the intensive ICT usage on the development of new cognitive styles (Dede, 2005; Howe & Strauss, 2000; Oblinger & Oblinger, 2005; Prensky, 2001a; Tapscott, 1997; Veen & Vrakking, 2004). It has therefore proved necessary to adapt learning methods and tools to these changes; teachers themselves are often required to have more "advanced" training.

This paper aims to summarize the current changes in education concerning the use of innovative teaching methods and to analyse the understanding of such changes by teachers and pupils. Pupils' grasp of their own learning is a relatively underexplored field in educational research, and yet it is paramount for effective lifelong learning. Therefore, we tried, on the one hand, to understand how teachers consider technology and its use in school teaching; on the other hand, to investigate the children's point of view, how they perceive technology in general, and its use in schools in particular. We focus on the following aspects: the differences in the use of digital tools by the two groups, the motivations leading to certain uses and/or non-uses, the teachers' pedagogical perspectives and their views on how ICT can contribute to the learning environment, their considerations on the current situation. In the final section, we evaluate the future perspectives.

We used focus group interviews to explore teachers' and pupils' perspectives on innovative learning strategies, particularly ICT-based.

The (digital) revolution in the Italian educational and school context under the current regulations

Technology seems to have permeated every single nook and corner of everyday life, from the professional to the private sphere. It covers essential tasks – *e.g.,* the activities carried out by increasingly precise and sophisticated industrial machinery or Artificial Intelligence – as well as ordinary activities – such as taking notes, ordering takeaway food and so on. These changes also affected social dynamics, inexorably conditioning the growth path of the

new generations. The use of Information and Communication Technologies (ICTs) covers every area of contemporary socio-educational processes and systems fostering technology-based innovations. From a technological point of view, ICTs in education are intended both as infrastructures (access to laptops, broadband internet connection, etc.), learning applications and tools, digital educational objects (games, videos, digital platforms, edutainment practices) implemented in a systematic and non-episodic way, so enabling education processes. From a pedagogical point of view, ICTs in education may contribute to improve teaching strategies and learning outcomes, to increase access to learning opportunities, to enhance the quality of education (Pandolfini, 2016).

Thus, in order to incorporate ICTs, school curricula should include specific training on critical and conscious use of new technologies, or at least take them into account, and use them also for didactical-educational purposes to mimic the learning styles of the new generations, at the same time developing new skills. In order to examine how these technologies reverberate in changing traditional teaching approaches and social representations of teaching, we need to consider the policy axis and specifically the link between ICTs innovations and policy choices (Pandolfini, 2016; Erstad, 2009).

Italy's policy advancement along this path has been very slow and is still incomplete so far (Bruni et al., 2019). A proper response from the Italian school system occurred only in the early 2000s with the digital classes and the inclusion of interactive whiteboards, which engaged the Ministry of Education for about 10 years of analysis and evaluation.

With the *La Buona Scuola* reform of 2015 and its National Digital School Plan (*Piano Nazionale Scuola Digitale* - PNSD), the theme of new media in schools assumes an increasingly important role. This new PNSD is a five-year operational plan articulated in 35 actions covering the 2015-2020 cycle. Within it, the theme of media in schools emerges in a more fitting way than in the past, focusing on different areas. Among the most significant proposals – and impacting particularly on the micro aspects of the teacher/student relationship, an area examined here – we highlight the following areas (MIUR, 2015, p. 27-31):

- *Access* – The PNSD recognizes the importance of making networking, technologies, content, and skills accessible and enabling for all, as the only way to implement innovative ideas effectively and efficiently.
- *Learning Spaces and Environments* – Schools must be helped to acquire digital solutions that facilitate environments for active and laboratory learning. Moreover, education in the digital age must not focus on technology, but on new models of didactic interaction that use it.
- *Students' Competencies* – For the first time, attention has been paid to the need to define the competencies that students need in today's work

market and to an idea of competencies in line with the 21st century, made of new literacy, attitudes, transversal competencies, also related to the understanding and production of complex and articulated contents. It is therefore considered essential to work on and improve *Information literacy* and *Digital literacy*.

- *Digital Content* – MIUR recognizes the importance of digital creativity, therefore it is committed to creating the right conditions in term of technology and access, so that digital content, in its growing variety, becomes the norm in education rather than an exception.
- *Staff training* – School staff must also be equipped and enabled to experience innovation. The training of teachers is another factor on which educational innovation must focus, trying to reach even those who are not naturally predisposed to the technological innovations. It is important to consider digital technologies as support for the realization of new educational paradigms.

The PNSD is structured in 4 primary areas (*Tools*, *Skills and Content*, *Training*, *Accompaniment*), in turn, articulated in 35 actions to be implemented during the five years of programming, related to the areas mentioned above.

However, it is only with the first proposal of the syllabus of Digital Civic Education in 2017 that we come to an explanation of what is expressed in the PNSD aimed at raising awareness of the changes dictated by the spread of new media while indicating the main actions to be implemented (Bruni, Garavaglia & Petti, 2019). The syllabus is but a summary pinpointing and recognizing the essential themes of digital social development to be included in the educational paths (MIUR, 2017).

Many institutions appear to have assimilated the directives of the syllabus of Digital Civic Education through the inclusion of media citizenship education in their curricula and the development of *Media Education* projects (*ibidem*)[1]. Both elements must proceed at a slow pace in the process

[1] At the national level, *Media Education* is considered as «a fundamental tool to master media techniques and culture to ensure those basic conditions for the exercise of citizenship rights in the world in which we live» (Falcinelli, 2019). Media education engenders three modes of intervention that conceive it as 1. *Education to the understanding* of media messages and the reality of the system of mass communications. It aims at promoting a critical understanding of the media both based on their different textual aspects (websites, hypertext, etc.), and on those dealing with subjects who produce the text and techniques of production, dissemination, and reception of messages. 2. *Education in the correct use* of the media. It applies the methodology of consumption analysis and is oriented towards the analysis of *habits*. It aims to make young people more aware of their media use behaviours and to promote greater awareness and ability to choose. 3. *Education to the production* of original media messages. It applies the methodology of the production workshops in different media-related fields and is oriented towards the analysis of *skills*. It aims to make young people express their thoughts and emotions through new languages, to stimulate their creativity and to develop in them the understanding of the media used through practical first-person use.

of acquiring skills which go from the tacit to the explicit, and then back to the tacit, thus focusing on the capacity of internalization and externalization of assimilated knowledge (*ivi*, p.18). Furthermore, one should always bear in mind that children often have – at the very least – basic digital knowledge.

At the European and non-European level, schools seem to be already reorganized to adapt to the changes in society 4.0. In addition to providing "new equipment", they accommodate the goals to be pursued, the concept of *learning*, the structuring of new bases to define curricula according to the demands of today's labour market. Furthermore, they adapt the spaces (classrooms, buildings) and the teaching staff to these changes (Livingstone, 2010).

Despite these evolutions, Italian schools are firmly attached to written culture, while at the same time trying to metabolize the digital world, as if they wanted to «change something to leave everything unchanged» (Midoro, 2015, p.8).

ITCs and innovative teaching approaches: impact, issues, and future perspectives

From a sociological point of view, we can investigate the impact of ICTs in education by distinguishing three levels of analysis (Pandolfini, 2016): macro, meso and micro-sociological.

The macro-perspective is related to the inclusion of ICTs in curriculum development and improvement in accessibility (physical infrastructures such as laboratories, libraries, etc., equipment such as computers, laptops, printers, projectors, whiteboards, etc., connectivity to the Internet) and development of digital learning resources. From this perspective, the school's technological infrastructure and the strengthening of its digital education projects depend on the investments and finances available to the school to improve its digital capital (Pandolfini, 2016; Cortoni & Perovic, 2020).

At a meso- level of analysis, the implementation of technologies is related to the institutional environment as expressed in the school leadership and management, the school culture and collaboration tools. Thus, the meso level refers to the role of ICT in lesson planning, managerial activities, relationship management with students, families, other schools, administrative staff, stakeholders, etc. and administration management (Pandolfini, 2016; Cortoni & Perovic, 2020).

The micro- perspective – which will be the main focus of this paper - refers to students' and teachers' practices and outcomes including the role of ICTs in improving learning outcomes, in stimulating knowledge building, problem solving capabilities, and digital competencies (Cortoni & Perovic, 2020)

In all three perspectives of the analysis of the impact of ICTs in education (macro-, meso- and micro-), the role of teachers and their digital competencies become essential both for improving learning curriculum and processes and for supporting students' critical awareness, responsibility, and assessment in using ICTs, digital media and contents (Cortoni & Perovic, 2020).

However, this process is rife with critical issues, mostly related to internal barriers or second-order barriers represented by teacher's pedagogical beliefs, attitudes, opinions, conceptions and approaches to teaching (Donnelly, McGarr & O'Reilly, 2011; Jääskelä, Häkkinen & Puttonen, 2017). While external or first-order barriers refers to meso barriers such as lack of infrastructures or equipment, training and support, which are easily removed through financial and reform efforts, internal or second-order barriers rooted in teacher's core beliefs are more resistant to change. They involve teacher beliefs about teacher-student roles, about the role of a teacher, the learning processes, the effectiveness of teaching methods and strategies, assessment methods.

We can distinguish between *teacher-centred* and *learner-centred* beliefs (c.f. Lim & Chai, 2008; Liu, 2011; Meirink et al., 2009; Norton et al., 2005; Smeets, 2005). The former prioritizes knowledge transmission through traditional teaching methods, the latter focuses on students' responsibility for their own learning and the teachers' role in supporting it. As Pandolfini (2016) points out, the differences between teachers in dealing with ICT highlight the separation between traditionalists and innovators: «The latter are teachers well-disposed to welcome new tools or methods potentially changing their professional activities, while the former are less open to innovation and changes in their teaching processes and routines» (*ivi*, p.47). Her analysis shows that those teachers enthusiastic about ICTs succeeded in using them despite inadequate infrastructure and institutional supports. Donnelly, McGarr & O'Reilly (2011) identify four types of teachers *contented traditionalist*, *selective adopter*, *inadvertent user* and *creative adapter*. The first two seem to be led by a learning-centred approach: *contended traditionalists* have a traditional view of teaching seeing no need for using ICTs and selective adopters use ICTs only in a narrow sense, only if they help students do better in their final assessment. The other two, instead, seem to be guided by a learning-centred approach: *inadvertent users*, due to the lack of complete digital competence, use ICTs but without a clear focus and in a quite uncritical ways whereas *creative adapters* provide a wide-scoping ICT-related resources keeping the focus on learning and empowerment.

We can say that traditional teachers emphasize the importance of past teaching methods and are concerned with the loss of written culture, overload,

and excessive exposure of children to the "information storm" of the web[2]. Innovative teachers, on the other hand, call for an adjustment, a complete restructuring of the educational system through the implementation and dissemination of ICTs (Colombo, 2016). As shown by recent research (De Feo & Pitzalis, 2016; Pitzalis & De Feo, 2019) the predisposition towards ITCs varies considerably and in general depends on the difficulty of teachers in dealing with tools that are characterized by rapid obsolescence.

There is no lack of proposals for mediation between the two poles, to create a bridge between the "old" and the "new" given that ICTs are now so widespread among the younger generations that going back would be unthinkable. Digital technologies should not be rejected, we must instead understand how they can facilitate and improve the old learning processes.

Teachers' beliefs also influence the type and pedagogical nature of the educational software they use with students. Particularly, traditional teachers tend to use skill-based transmission software (practice-based) aimed at enhancing students' skills, while innovative teachers are more likely to use open-ended constructivist software and to build learning environments (Smeets, 2005; Niederhauser & Stoddart, 2001).From the pedagogical point of view, the most emphasized aspect in the relevant literature concerns the teaching strategies and hangs on the transition from a passive epistemology of learning, regulated by the teacher, to an active epistemology in which knowledge is a self-regulated process (Mynbayeva, Sadvakassova & Akshalova,2017). Indeed, the teacher is no longer seen as the undisputed repository of a universal knowledge, abstract and independent from a reference context. On the contrary, knowledge is the product of an active construction by the subject, closely related to the concrete situation in which learning takes place and born from social collaboration and interpersonal communication (*ibid.*). The vertical teacher-pupil hierarchy is set aside, sometimes attenuated, favouring instead a greater dialogue, comparison, and stimulus and promoting learning through play[3]. ITCs are

[2] For example, about mnemonic processes, the spread of online information has highlighted the risk that the attention of young people today focuses more on the research method, the source, rather than on the content of the information itself. The average attention span has decreased tenfold compared to 10-15 years ago (Mynbayeva, Sadvakassova & Akshalova, 2017).

[3] *Gamification* – entails adopting the dynamics and mechanics of games and video games for apps and/or websites to be used during the lesson. Its use in teaching aims to increase the involvement of children – and adults, if in advanced training contexts (Petruzzi, 2015); *Game-based learning* – unlike gamification, this method is based on the actual use of games and videogames as educational tools to promote learning. Both practices pursue a fun-based learning process *Flipped classroom* or *Flipped learning* – they consist in "moving" the lesson – and therefore the concepts that the teacher would have exposed in a traditional frontal lesson – to the students' "home", so that they prepare the material previously provided and go to school with a common basic knowledge that will be there increased and enhanced through group tests, practical exercises, comparisons, etc. *Peer learning* – its basic prin-

valid tools to implement and encourage these strategies in the classroom: innovation is encouraged without completely erasing past manual activities or practices that continue to be present, also favouring a critical approach to new technologies.

It is assumed that there is no "right" and "wrong" knowledge, just as there are no optimal learning styles and rhythms. Knowledge is an operation of semantic interpretation that the subject activates whenever they want to understand the reality that surrounds them. The ultimate goal is not the total acquisition of specific pre-structured content and data once and for all, but the internalization of a learning methodology that progressively makes the subject autonomous in their cognitive paths.

The purpose of education and training will no longer be to propose codified knowledge to the subject but make them know the specific knowledge they need: the real knowledge that is promoted is the one that will help them acquire further knowledge (Papert, 1994). The success of constructivism is linked to the bond uniting this new pedagogical paradigm with the emergence of promising new dialogical forms of knowledge construction offered by the new technologies and the web. It is no coincidence that experiences explicitly recognized as constructivist educational environments include learning communities. In this sense, useful indications have also come from the recent connectivist model, *e.g.,* the theory proposed by Siemens (2006). This model emerges together with the development of the communication network and the new opportunities offered by its use in teaching: knowledge is obtained through interaction with the network community. Theories and didactic problems are therefore considered not only from the point of view of the internal relations between teacher and student but as a didactic and at the same time social environment, open to innovation and interference with dynamic changes. By shaping the skills of the subject, we simultaneously design the formation of social, communicative, and life skills (*ibidem*).

According to Prensky (2001a), teachers should be more responsive to current dynamics, *run* with them and the students, follow their progress. However, to be thus operational implies the support of institutions in providing adequate and relevant funds and tools. This new didactics

ciple is the transmission of knowledge between people of the same level in terms of age, status, problems and so on, to create more empathy, trust, comparison and understanding (D'Alessio, Laghi & Giacalone, 2010). *Cooperative learning* – an inclusive method that allows a "common construction" of "objects", procedures, and concepts, going beyond mere working in groups. It addresses the group-class as a set of people who collaborate for a common result, working in small groups. *Blended learning* – is based on the combination of e-Learning techniques with classical teaching methods, through the use of media such as tablets, smartphones, DVDs, etc. This method enriches the interaction between teachers and students, improving communication between the two parties and facilitating autonomous and collaborative learning (DeA Scuola, 2016).

aims to stimulate reflection on the practices to be used, on how they can be innovated using also (but not only) technology and on the conditions necessary for them to be profitably implemented in schools. It also responds to the following needs: 1) combining knowledge and experience, combining theoretical aspects with practical actions, moments of informal and formal learning; 2) encouraging the interaction of different groups of students.

A new generation of students

Due to the pervasive diffusion of ICTs, education institutions are populated by a new generation of students who have been differently defined: *digital natives* (Prensky, 2001a, 2001b), *millenials* (Howe & Strauss, 2000), *netgeneration* (Oblinger & Oblinger, 2005; Tapscott, 1997, 2008), *homo zappiens* (Veen & Vrakking, 2004), *instant messaging generation* (Lenhart, Rainie & Lewis, 2001), *New Millennium Learners* (Pedrò, 2007).

Studies on primary students use of technology have demonstrated that also primary student are sophisticated consumers of ICTs (Selwyn & Bullon, 2000; Aesaert & van Braak, 2014). They frequently are exposed to technology outside of schools, have domestic access to a games machine, to home computer, tablets, parents' smartphones, etc.

Already in 2012, the "National Report on the Condition of Childhood and Adolescence in Italy 2012", by Eurispes – Institute of Political, Economic and Social Studies, part of the official research bodies of the Ministry of Education, University and Research (MIUR henceforth) - depicted modern children as «completely immersed in technology. They have one hand on the mouse and a screen in front of their eyes, with the other hand they write messages on their smartphone, an earphone brings music to one ear and with the other they listen to the TV tuned to their favourite channel. This is how young people move in the meanders of the most modern technology, creating a "multitasking" generation (…) Young people live completely immersed in technology, each with their own preferences and according to the level of technical literacy acquired, but all in symbiosis with communication tools, computer equipment and cutting-edge digital technologies» (ivi, p.188).

According to Aesaert and van Braak's study (2014), primary school pupils generally consider themselves to have a high ability in retrieving and processing digital information, and in communicating through computers and the internet.

The techno enthusiasts call for the development of new technological, cognitive and collaborative abilities which would make obsolete educational systems (Dede, 2005; Howe and Strauss, 2000; Oblinger & Oblinger, 2005; Prensky, 2001a; Tapscott, 1997; Veen & Vrakking, 2004).

The techno skeptics call for differentiation: digital competencies depend on access, use of technology, social, cultural, and economic capitals (Kvavik, 2005; Margaryan & Littlejohn, 2011; Nasah et al., 2010; Thinyane, 2010). Some emphasise the negative impact of technologies on cognitive capabilities such as memory, attention and way of thinking. The huge availability of information at any time would change the mnemonic processes and their structure forcing to remember more the place or the way in which the information is retrieved than the source or the content. As to attention the pervasive use of technologies would lower concentration capacity and concentration duration. Moreover, logic way of thinking would be replaced by *clip thinking*, based on processing of visual images (Soldatova et al., 2015).

Regardless of whether the internet is conceived as the cause or consequence of social and cognitive changes, whether its potential is accentuated rather than its problems, it is important to focus on the new *lifestyles* of children, asking ourselves questions such as "How do they learn?", "How do they play?", "How do they interact?", "How do they participate?", "How do they face risks?", reformulated according to their relationship with the internet (Livingstone, 2010).

The use of information and communication technologies touches every area of contemporary socio-educational processes and systems. In examining how these technologies reverberate in changing traditional teaching approaches and social representations of teaching, they call into play both the more general plan of policies to support and implement ITC and the teacher/student relationship (Erstad, 2009). Colombo points out that «The Digital Era not only leads a subject to open his or herself to a myriad of new learning contents (learned, published, and transmitted) but also radically changes the way one thinks. This means teachers must re-learn the objects he/she selects, processes and transmits to students. And, for pupils, it deals means searching for a "cognitive" correspondence between his/her "natural" repository and the teacher's» (2016, p.3).

On the didactic methodologies to be used with digital natives, Mark Prensky (2001a) observes that: «Today's teachers have to learn to communicate in the language and style of their students. This doesn't mean changing the meaning of what is important, or of good thinking skills. But it does mean going faster, less step-by-step, more in parallel, with more random access, among other things. Educators might ask "But how do we teach logic in this fashion?» (ivi). While it is not immediately evident, we do need to figure it out.

Thus, apart from enthusiasm or skepticism, a new set of competences emerge with the emergence of technologies. These are a) Digital literacy or ICT literacy, meaning a complex combination of skills, abilities, and knowledge on both the technical-informatics field and more transversal

aspects: critical thinking, problem-solving, collaboration, research; b) Media literacy, to refer to the modes of communication and personal expression and their mediation by children. This dimension is focused on understanding the different media languages which, being symbolic systems, do not merely reflect reality, but provide a narrative – and a good narrative requires mastery of the language of its medium. c) Information literacy, the ability to recognize when information is needed and to know how to identify, evaluate, organize, use, and communicate it in its different formats, also depending on the contexts of reference (Midoro, 2015).

They are supposed to encompass technical competencies to include the awareness and ability of individuals in using technologies appropriately so to «(1) make responsible choices and access information [..], (2) analyze messages [..] by evaluating the quality and credibility of the content, (3) create content [.], (4) reflect on one's own conduct and communication behaviour by applying social responsibility and ethical principles, and (5) take social action by working individually and collaboratively to share knowledge and solve problems [.]» (Hobbs, 2010: vii–viii). It seems to be clear from this and other definitions of digital literacy (Aviram & Eshet-Alkalay, 2006; Eshet-Alkalai, 2004) that it is a broad concept entailing more than the mere ability of using software and apps to include media and visual literacy, creative and problem-solving thinking, collaborative and relational capabilities.

Youth education and training, as well as school realities, are strongly affected by these changes because the new generations, with the spread and proliferation of PCs, tablets, smartphones, social networks, APPs, together with a voracious use of the Internet and its channels, have assumed habits, attitudes, ways of approaching reality, their peer group, and adults exceedingly different from "traditional" ones (Aesaert et al., 2015).

The natural predisposition of children today has led to the observation that they acquire digital skills independently, informally, and progressively as they grow, on a par with learning to walk, to tie their shoes, to dress themselves. However, this does not imply that their "know-how" is necessarily correct; education (in general) and school (in particular) are paramount for channelling these "innate" skills in the right direction.

This is especially necessary because some evidence suggest that technology alone is not able to foster digital competencies: there seem not to be differences in cognitive terms between children who use technology in their infancy and who do not. Instead, there seem to be a negative impact of technology use on language development time with strong users being late speakers (Bruni, Garavaglia & Petti, 2019). This result confirms the crucial role played by educational institutions, and in particular by primary schools, in implementing educational interventions specifically targeted to

develop critical, ethical, and socially aware personalities, as well as to reason following two main objectives (Calvani et al., 2012):

that everyone learns the same elementary technological skills and abilities, thus eliminating disparities due to cultural and socio-economic differences;

that the integration of technological notions and skills that young people – already at an early age – could acquire spontaneously through autonomous practice is guaranteed, to create a more structured and articulated cognitive scheme, adequately correlated to other significant competencies.

The present research lies precisely in this context and is focused on analysing how and how much the advent of technology has impacted in elementary school. We started from a necessity, rather than a hypothesis, *i.e.,* to detect the current outcomes of these changes in the school environment through direct comparison with the main actors involved: teachers and children.

Methodology

The present study used focus group interviews to explore the teachers' and pupils' perceptions of technology in primary education.

Focus groups can be construed as a group interview, a planned discussion about a defined area of interest designed to collect individual and collective views in a non-threatening environment where group interaction is used to encourage in-depth discussion (Colella, 2011; Krueger, 1994; Kitzinger, 1994; Carey, 1994). The discussion takes place under the guidance of a moderator who facilitates interactions in a non-directive way.

Focus group interviews are frequently used in qualitative educational research (Vaughn, Schumm & Sinagub 1996). However, their use has been limited mainly to research on adults (Gibson, 2007). Only in recent years, due to the increased emphasis on the entitlement of children to have their voice heard, we have witnessed an expansion in their use with children and youngsters.

As for all qualitative methods, also in the case of the focus group individuals involved cannot be considered representative of the population. Instead of representativeness, we need to consider their significance, that is their capacity of covering the variety of social situations instead that the need of reproducing the characteristics of the target population (Corbetta, 2003).

We carried out four homogeneous focus groups (two with teachers and two with pupils) in two primary schools located in Pagani (Salerno) at the end of 2019, interviewing 15 teachers and 15 pupils in total. Focus groups

with pupils were carried out in their classrooms whereas focus groups with teachers were carried out in teachers' room and lasted more than one hour.

Working with younger children, we preferred small, mixed-gender groups, to allow for the participation of all pupils. In line with methodological literature on research on children (Kennedy, Kools & Krueger, 2001; Green & Hart, 1999; Roose & John, 2003), we considered age variation in the group composition. Thus, we preferred 1-year age difference between young participants since style, ability, sensitivities, and level of abstraction differ substantially at different ages. We avoided focus groups on children under 6 years which are not advisable due to limited language skills (Gibson, 2007). Moreover, gender was another composition factor considered. We opted for gender heterogeneity. Thus, the students' sample includes 20 pupils (10 for each focus group) – equally divided between 9-year-old and 10-year-old students, males and females. The teachers' sample includes 20 teachers (10 for each focus group) equally divided between 5 subjects: Italian, Math, English, Religion and Support/Resource teachers.

The exploration of teachers' and pupils' perceptions and practice of technology in education is constructed around three dimensions:

- the factors such as first-order or second-order barriers and facilitators such as personal opinions and beliefs influencing the use of technology by teachers and students;
- the areas of learning through technology (curricular content acquisition, general knowledge acquisition, sharing capabilities, interactional capabilities, etc.);
- the practical tools for teaching and learning that is the learning activity types which may range from presentational tools (e.g., whiteboards), to subject-based (e.g., math or foreign language simulation apps), group-based (e.g., discussion tools such as brainstorming) or competence-based tools (e.g., wikis, web 2.0, game design).

Once the focus groups were completed, the next step was to transcribe the conversations that took place. Since the act of transcription is itself an interpretive process and the oral language is decontextualized into the written word, the transcripts needed to accurately capture the interview experience through verbatim transcriptions including oral elements such as pauses, silences, non-verbal expressions, etc.

Teachers' beliefs about the use of technology in education

As highlighted in the literature review also in teachers' perspectives we can distinguish two different views and pedagogical thinking about the use of technology by teachers: a *constrained* view of technology deriving from

a teacher-centred approach and a *deliberate* vision of technology deriving from a learning-centred approach.

Teachers with a constrained vision of technology seem to see it as a top-down decision, not a choice and to view it just as a tool to enhance traditional methodology, an extension of traditional methods to present information and deliver lessons, so expressing a passive learning vision:

> *Technology should be used as supplemental rather than to replace the teacher in the classroom (Teacher, 45-year-old).*

Among some of the teachers who express a teacher-centred approach there was evidence of apprehension about their status and reluctance to change due to the fear of increasing work and commitment:

> *I really have a deep fear of technology in terms of how it will increase our workout (Teacher, 47-year-old).*

The reluctance and hesitation may also be due to difficulty in moving away from one's comfort zone and from a fear of technology combined with the attitude to see their traditional methods as having better results.

Those who express a teacher-centred approach are also those more sceptical regarding the use of technology in student learning and the impact of technology on student's competence and capabilities:

> *I still don't believe that just because we are presenting information via the computer the learning is going to get better as compared to the traditional notes (Teacher 44-year-old).*

Concern regarding the value of technological change to student learning outcomes was raised by several teachers. Moreover, these teachers felt that students should first learn contents without computers, apps, and technological supports.

> *I don't think that these innovations of technology make a good difference in student learning. Instead, I think that they make a negative difference. You cannot learn thinking skills from technology. Thinking, critical, and discussion skills must be learned face to face (Teacher 48-year-old).*

This because there was an overriding concern that technology could be detrimental to the education process driving toward apathetic behaviours of children, lack of curiosity, imagination, initiative and reflexivity, lack of patience in seeking a solution, lack of memory, excessive sense of immediacy, a decrease of the average duration of attention:

> *These children must write with pens not to lose this manual ability. They must read. I am an old-fashioned teacher and believe that technology has been a regression for the students, not progress because children use it in the wrong way. If you give them an online research, they bring you a piece of paper, but they do not have even read it. It is much better to go*

> *to use the encyclopaedias and dictionaries. They do not know anymore how to use them because computers have made research easier (Teacher, 60-year-old).*

> *An over exposition to computers leaves nothing for the students to do. Computers do all the thinking for the students so that they do not understand what is really going on. If overexposed to the computer, they can also become fast in using it but they lose the capacity of waiting. That is to say, their speed is because they are children of technology […] they want the solution to the problem immediately, there is no more reasoning […]. It is a consequence of the technology that accustoms them to be fast, to possess immediately in a fast way what they want (Teacher, 44-year-old).*

> *I notice that they have a very short memory, that is very immediate, but they forget easily (Teacher, 51-years-old).*

> *Students would learn much more with field-based work than with technology and computers. Face-to-face interactions are the starting point of group work; discussion skills must be learned first. Only after that, you can use technology (Teacher, 65-year-old).*

In this last statement, there is also a concern with authenticity and the teachers' feeling that learning without technology is more real and authentic.

This vision emphasizes the primacy of face-to-face interactions in learning:

> *The use of tablets and computers needs to be marginal in a lesson. Otherwise, there is no more discussion and dialogue. We do not have to lose authenticity and reality (Teacher, 65-year-old).*

On the contrary, the opposite vision sees technology as a deliberate choice of teachers who need to implement a learning-centred approach through technology as a free way to change the learning process, increase student interaction and encourage problem-solving:

> *The use of technology needs to be generative. In other words, we as teachers need to provide instruction that will scaffold students' pedagogy within the classroom toward more authentic, learning-centred activities for the students (Teacher, 60-year-old).*

Teachers who express a learning-centred view believe technology can transform the learning process with students becoming active learners:

> *The integration of technology into the lesson does not necessarily imply my gathering and developing the lesson. In this way, I would do all the thinking. Instead, I should have had the students think and figure it out!*

However, this capacity is contingent upon the teacher: not all teachers would embrace technology and use it to its full potential, but few teachers

will be able to be effective, becoming orchestrators of technological experiences. Only when technology is used interactively, it would change the role of the teacher from a mere deliverer of knowledge to one of a facilitator of knowledge who encourages learner-initiated behaviours. Within this perspective, the process is more important than the content, as emerge in the words of this teacher:

> *Students don't need that I explain content. They can get it from a book. They need that I drive them to acquire the knowledge base to help them to find information autonomously, to develop problem-solving capabilities and creative thinking (Teacher, 45-year-old).*

> *Teaching and learning need to become a far more collaborative process thanks to technology with adults and children being engaged in both as in a learning community (Teacher, 60-year-old).*

An overriding concern expressed by several teachers – both those expressing a teacher-centred and those expressing a learning-centred view - pertained to the availability of the equipment necessary to remain competitive in a technologically-driven society:

> *The number of computer and tablet is very limited. Moreover, we do not have enough space to equip technology classes and the internet connection is not always working (Teacher, 54-year-old).*

The use of technology by pupils

Pupils also express two different visions of technology: the first seems to be a more individual view, the second a more collective and social view.

Those who express an individual view emphasize the role of technology in extending individual abilities.

Pupils frequently mentioned how technology and particularly the whiteboard assisted their understanding especially through the visual display of information and the use of colour and movement. For example, the multimedia mode of communication which by linking visual and verbal elements complemented each other is seen as promoting effective learning:

> *The pictures help you to understand what the teacher is talking about (Girl, 10-year-old).*

The dimension of the game as expressed in the use of role-playing or real-life simulation apps is also emphasized as a means to enhance understanding and make learning easier and fun especially in specific subjects (such as maths and foreign languages) and sometimes it changes their (pre-) conception of specific subjects:

> *I do not like math, but I like math on the interactive whiteboard because I like the games and it is easy to understand (Boy, 10-year-old).*

> *Boring questions become coloured with technology. Technology helps you. You can just go into the internet and find out information (Girl, 9-year-old).*

> *Difficult matters and subjects are easier to understand because you can see something happen rather than listening to your teacher describing it. Learning how to say something in English is simpler with apps (Boy, 10-year-old).*

By making lessons less boring, children attribute to the technology the ability to keep their attention:

> *I prefer watching a lesson and a practical explanation on a tablet through a game, or on a video on the whiteboard instead of listening teacher speaking for hours (Boy, 9-year-old).*

Moreover, pupils seem to appreciate the increased speed of process which is a motivating factor for some children to use computers to ease the process of researching words (instead of a physical dictionary) or researching specific topics.

Those pupils who express a collaborative vision of technology, stressed the possibility of group work, of dividing tasks and roles during learning activities, of constructing new knowledge, deepen understanding or invent new skills together. They stressed the possibility of sharing thoughts and actively contribute to propose ideas, volunteer information in class, discuss the learning content together through social learning.

> *Whiteboards, smartboards, interactive educational group games help you mix your ideas and work together (Girl, 10-year-old).*

They emphasize the interaction with others as a crucial dimension in learning as in the case of technologies which stimulate pupils to find out things together with fellow pupils (web 2.0, wikis, game design). Apart from facilitating students' interaction, technology seems to ease class interaction and participation making teachers and pupils able to discuss, modify and extend ideas in a shared arena.

A typology of learning strategies/educational patterns

From the combination of the teachers' and pupils' visions of technology we built a typology of learning strategies which differ for the area of learning, the vision of technology, the pedagogical practice and the type of technology used (fig. 1).

Fig. 1 - A typology of learning strategies

Vision of technology by teachers	Vision of technology by pupils: Individual use	Vision of technology by pupils: Social use
Constrain	***Learning through acquisition*** Areas of learning: acquiring basic skills ICTs to support traditional teaching Whiteboard	***Learning through cooperation*** Areas of learning: social gains, extending knowledge of the world ICTs to support social learning Brainstorming, case study
Choice	***Learning through gaming*** Areas of learning: acquiring subject skills ICTs to support subject learning Role-playing, simulations, virtual reality	***Learning through collaboration*** Areas of learning: developing dispositions to learn ICTs to support competence building Web 2.0, wikis, game design

It is well known that any attempt to develop a typology is based on the prevalence criterion. However, the social reality is much stronger than any abstract scheme and, although the proposed typology is useful for a deeper understanding of different learning strategies, it is essential to also consider the overlaps among different types.

The first strategy derives from a constrained vision of technology by teachers and its individual use by pupils and is named *learning through acquisition*. ICTs in the classroom are used as a way to sustain traditional teaching and technology is an optional tool, a tool among others, a possibility to support learning content. This is a skill-based strategy of formal education where student play a relatively passive role while the teacher uses the technology as support: multimedia capabilities are exploited to improve presentational quality through pictures, animation, videos and hypertext for example by using whiteboards. Individual learning technology is used mainly to complement rather than change existing pedagogical practice supporting autonomous learning. Students are supposed to follow rather than initiate action. Technology does not change the form of learning.

The second strategy derives from the use of technology as a deliberate choice of the teacher and its individual use by pupils and is named *learning through gaming*. It is based on integrating games into learning, transcending the formal/informal context for leaning. Educational games can be used for both entertainment and learning making connections between different sites and types of learning. Games provide contextualized environments where children can experiment and make mistakes; they provide contextualized inputs, challenges and competitions to engage young learners in self-

directed learning. They are mostly used for improving learning and student achievement in specific subjects such as mathematics and foreign languages without students realize that they are learning and making learning fun and easy. Students engage in digital experiences which mirror the complexity nature of real-life experiences through virtual reality, simulation and role-playing apps.

The third strategy derives from a constrained view of technology by the teacher and a collective view by students and is named *learning through cooperation.* It uses self-contained tasks and focuses on joint activity to extend knowledge of the world, support more positive relationships, mutual trust, more positive perceptions of other ethnic groups and individuals with disabilities, etc. Here technology is not used to transmit basic skills but to support informal learning such as exchange of information and discussion in horizontal variations in the expertise held by students comprising a group. For example, technology is used to support students proposing and explaining ideas to each other through brainstorming, case study and other traditional group teaching methods so to help acquire relational skills with an impact beyond immediate group context.

The fourth strategy derives from the deliberate use of technology by teachers and a collective vision of it by pupils and is named *learning through collaboration.* Technology is used to support pupils' active learning through open-ended types of ICT in educational practice. This learning strategy involves a new way of interaction between teacher and students and a certain innovation in practical activities such as discussion forums, Web 2.0, wikis, game design. In this strategy students collaborate to solve problems with technology taking responsibility for learning and determining the direction of the learning experience often through trial-and-error processes (independent learning), so reducing dependence on the teacher. This strategy is supposed to extend the class discussions outside the classroom supporting children's development as confident and self-directed learners and putting students in the position to construct their understanding and become resource managers in a broad learning community.

Discussion and conclusion

As technology advances as an essential component of the educational environment, it becomes critical to develop an awareness of how it is being used in the classroom and how it will impact learning processes and outcomes. This was the aim of this research which analyse the process of adoption and diffusion on both sides of the educational process. Findings were indicative of several views and attitudes of the participants regarding technology. Pupils' understanding of their own learning is a relatively

underexplored element in educational research, but it is extremely important to get the pupils' perspective on new technology. Indeed, for technology to take society and education into a new learning age, pupils also need to be technologically proactive.

There seem to be two opposite visions of technology. The first one includes the supporters of the traditional model of education and the vision of technology as detrimental to learning and a constraint for the educational process. This vision, which includes 2 learning strategies identified (learning through acquisition and learning through cooperation), expresses adherence to traditional pedagogy and reluctance to change traditional learning methods and is prevalent in the primary schools analysed. This stance is in opposition to the minoritarian vision of technology as learner-centred, a vision which emphasizes collaboration, student participation and democratization of education to enhance personal growth.

Most teachers express the first vision seeing the use of innovative teaching technologies as an institutional constraint and not a deliberate choice, regardless of their age. They seem to be technology-sceptics and express several concerns about the use of technology in education. A primary concern was a perceived lack of equipment in the schools. Moreover, teachers fear a lack of content, authenticity, and dialogue in technology. This because there was an overriding concern that technology could be detrimental to the education process.

Only a few teachers saw the appropriate use of technology as one which would change the learning process.

In our discussion with the children, they demonstrated a great capacity of reflexivity which is incoherent with the teacher's sceptical view of their cognitive processes. Pupils indicate the visual display of information and the use of games as having an important influence in supporting and maintaining the learning process making it fun and easier. Moreover, they report that whiteboards, educational APPs and other devices enhance the value of learning together, sharing and the positive impact of social learning. An important finding is that in pupils' views of learning, visual and verbal social learning is particularly prominent. How information is presented, particularly through colour and movement, is seen by the pupils to be motivating and reinforces concentration and attention. The range and scope of responses to computer use highlighted in this paper would suggest that the vision of school children as unquestioning consumers of technology is misleading.

Assessing teachers' and pupils' perceptions of technology can facilitate effective decision-making. The paper helps to answer questions related to the assumptions upon which the learning objectives are constructed, how the learning experience needs to be designed to achieve effective learning

objectives, the most appropriate media, and the expected outcomes. The most effective learning strategies in primary schools seem to be *learning through collaboration*. The indications are that technology may be an effective tool for facilitating the learning process, especially where pupils' and teachers' participation is full as in an open-ended learning arrangement with teachers creating an intellectual environment where he/she is no longer the all-knowing controller of activities but is the explorer with the pupils.

This is coherent with a shift in pedagogy and in the conception of education which expand its scope of meaning and understanding introducing competence and personal-oriented approaches as complementary to skill-based ones. Thus, learning strategies need to shift from knowledge and skills to the formation of competencies and from reproductive methods of teaching to innovative ones requiring the active use of innovative technologies. This cannot be realized without effective access to equipment, timely training programs, availability of technical expertise and appropriate incentives.

This research is not free from limitations. First, the types of learning strategies were not intended to be exhaustive but to function as a framework to enable us to identify more clearly the broad areas of learning that can be supported by ICT.

Second, the constant evolution of technology, pedagogy, and content together with the context-dependency of technology use, often brings new learning activity types to light. This means that our typology is not a static entity but rather continually evolving as we change context and develop new technologies, new ways of representing content and new ways of supporting learning.

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