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Innovation and education systems: teachers experiencing Interactive Whiteboards

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Abstract- The article aims to provide a critical perspective on the ongoing Information and Communication Technologies' application in education, analyzing the development of technology-based school innovations and their effective implementation. It presents an evaluation case study referred to an Italian government program for teachers' professional development aimed to develop and to improve the educational practices innovation through the diffusion and the use of Interactive Whiteboards in Italian primary and secondary schools. The aim is to identify some improvements factors towards different types of technology-based school innovations, taking into account the translation process from the starting of innovation to its implementation. The article provides some reflections to better understand the concept of innovation in education sector, mainly focusing on technological innovations trough the use of new technological tools in teaching and learning processes. It identifies critical success and failure factors for school technology-based innovation, deepening, in particular, teachers' point of view, investigating their experience in experimenting the use of interactive whiteboard in classroom. The case study provides some empirical findings that underline the crucial role of teachers to ensure the promotion of education systems' innovation through the use of new technologies in educational practices, as well as the need to provide them adequate professional development opportunities to reduce the still existing digital divide in school systems. This means wonder about what this implies for education and training policies and how policy makers could promote technology-based school innovations, trough suitable institutional and government initiatives aimed to innovate educational methods and practices in order to improve both the services provided to studentsand teachers' professional competences.

Index Terms- Educational innovation, Technological innovation, School systems, Teachers, Interactive Whiteboard

I. INTRODUCTION

Education systems are crucial to ensure the competitiveness of the European economy and EU Member States have recognized the potential of ICTs (Information and Communication Technologies) as main tool to fulfill the objective of wider diffusion of 21st century skills (Brinkley et al., 2010). Among these, the development of technology-related competences is increasingly becoming an integral part of the goals of compulsory education since, in a knowledge economy driven by technology, people who do not acquire and master such competencies may suffer from a new form of digital divide that may affect their capacity to fully integrate into the knowledge economy and society (OECD,2010a). Thus, European Commission has emphasized the promotion of education systems' creativity and innovation, including through the use of new ICT tools and teacher training, as one of the priority areas for the first cycle of the Strategic Framework for Education and Training (ET 2020) (Eurydice, 2011). On this point, already in 2001 the OECD' report "Learning to change: ICT in Schools" (OECD, 2001) has indicated the key role of ICTs' introduction in schools not just for teaching and learning processes' improvement, but also for Countries' full development. Recently, this has been confirmed by "Europe 2020 strategy", in which five of the seven flagship initiatives aimed at promoting economic and social growth in the European Union encourage the use of ICTs, stressing the need of developing technology-related competences for improving life chances for all (European Commission, 2012). During the last decades it has emerged the important role of new technologies in facilitating the process of globalization of economies and societies and technological learning (Carayannis, 2001) and knowledge have become crucial factors of economic, social and entrepreneurial development, which empower people across the world in taking advantage of opportunities and changes unknown and unexplored until recently (Carayannis et al., 2006). So, the role of ICTs in the creation, diffusion, absorption and use of knowledge for development has been shown to be instrumental and with increasingly substantial and emerging potential (Carayannis & Sipp, 2005; World Bank, 2010).

Innovation in education sector

Specifically referring to the education sector, policymakers are increasingly interested in best solutions to promote innovation, focusing, in particular, on how to create more innovative environments for teaching and learning, as recently confirmed by CERI's Innovation Strategy for Education and Training (OECD, 2010b). More in detail, we can define educational innovation as "any dynamic change intended to add value to the educational processes and resulting in measurable outcomes, be that in terms of stakeholder satisfaction or educational performance" (Pedrò, 2010:12).

The Oslo Manual for measuring innovation (OECD, 2005) provides a definition of "technological product and process (TPP) innovations", that implies new technologically implemented products (referred to both goods and services) and processes. More in detail, "technological product innovation" can take two broad forms: 1. "technologically new product", that is a product whose technological characteristics or intended uses differ significantly from those of previously produced products. Such innovations can involve radically new technologies, can be

based on combining existing technologies in new uses, or can be derived from the use of new knowledge; 2. "technologically improved product", that is an existing product whose performance has been significantly enhanced or upgraded. A simple product may be improved (in terms of better performance or lower cost) through use of higher-performance components or materials, or a complex product which consists of a number of integrated technical sub-systems may be improved by partial changes to one of the sub-systems. On the other hand, "technological process innovation" is the implementation/adoption of technologically new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or production organization, or a combination of these changes, and may be derived from the use of new knowledge. The methods may be intended to produce or deliver technologically new or improved products, which cannot be produced or delivered using conventional production methods, or essentially to increase the production or delivery efficiency of existing products. In education sector, TPP innovations typically occur at the classroom level, involving teaching and learning: for example, a product innovation can be a new or significantly improved curriculum, a new educational software, etc., while a process innovation could be referred to a new or significantly improved pedagogy (OECD, 2008).

Other types of innovations are "organizational" and "marketing" innovations. The former ones include the introduction of significantly changed organizational structures and new organizational methods in workplace organization or external relations. The latter ones include new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. In education sector, organizational innovations can for example be a new way organization of work between teachers, or organizational changes in the administrative area, while marketing innovations can for example be a new way of pricing the education service or a new admission strategy (OECD, 2008).

The Oslo Manual also emphasizes the contextual dimension of innovation, so that, if something is well established in one context, this does not preclude it from representing an innovation in another. This largely depends on the scope or scale of perspective adopted in considering the innovative nature of a product or practice, so that it is important to consider if the new product or practice in a particular context is invented or imported or duplicated (Lubienski, 2003, 2009). Thus, in order to better understand technology-based school innovations it is important to consider not just internal school characteristics, but also external environment in which each school is embedded.

Since school has to be considered as a "complex organization" (Gasparini, 1974), it seems to be useful to refer to the "3P" construct of innovation measurement, that simultaneously considers three critical firm-level factors related to a firm's innovation capabilities: *Posture*, *Propensity* and *Performance* (Carayannis & Provance, 2008:92-93). *Posture* refers to an organization's position within the greater innovation system of its environment (i.e. region, industry, technological domain) and it is exogenous to the innovation process being measured. Specifically, *posture* comprises a firm's state along three dimensions: the organizational, technological and market life cycles, reflecting its readiness to both engage in and benefit from innovation (Damanpour, 1991; Hauser et al., 2006). *Propensity* is a firm's ability to capitalize on its posture based on cultural acceptance of innovation. In this way, propensity is an intangible reflection of processes, routines and capabilities established within a firm. A firm may possess adequate resources and consequently higher externalized innovation stature, yet have an underdeveloped capacity for innovation due to cultural or other constraints. *Performance* is the lasting result of innovation. This part of the framework comprises three levels: output, outcome and impact. Outputs occur as the immediate, internalized results of innovation (for example, new product introductions). Outcomes include mid-range results such as revenues contributed by new products. Finally, impacts represent more lasting, long-range benefits that accrue to the firm from its innovative competence and are transformed into results for the firm's environment too. On this last point, and specifically referring to technological innovation, the question to be carefully considered concerns how and to what extent it determines an increase in economic development.According to the neo-Schumpeterian approach to change, Information and Communication Technologies introduce to a new age (Freeman, 1987), which at the beginning may seem inconvenient due to the necessary adjustments required during the starting stages, but is surely foreboding advantages (also from an economic point of view) in the long run. This leads to the broader concept of e-development, that can be defined as "a set of tools, methodologies, and practices that leverage ICT to catalyze and accelerate social, political and economic development" (Carayannis & Provance, 2008:422).

Basing on such assumptions and specifically referring to education systems, the complexity related to technology-based school innovations and the ways trough which realize them emerge clearly analyzing the experiences occurred in most countries and education systems around the world. Since many years, policy makers have supported the adoption and diffusion of new technologies in schools through their budget allocations (i.e. significant investments in ICTs) and by supporting professional development programs for educators aimed at using ICTs in the classroom. However, these two levers of support do not appear to be enough to compel the widespread educational change and innovation needed to transform the majority of schools and teachers. In most countries and education systems around the world, real change in education is still happening in only a very few cases, driven by heroic individuals who innovate their teaching practices and their schools in relative isolation (Langworthy et al., 2010:105).

II. Teachers' professional development and ICT: the Italian Plan for diffusion of interactive whiteboard

Since the integration of digital media and technologies in education has become a policy priority throughout Europe, in the majority of Countries it has been observed a deeper embedding of ICTs in teacher training at several steps, both during initial teacher education, both in continuing professional development (OECD, 2010a). In fact, as showed by several studies and empirical researchers (European Commission, 2010;

UNESCO,2011), teachers play a key role to start and develop innovative educational practices trough the successful integration of ICTs into the classroom. Thus, professional development initiatives seem to be crucial both to provide them with a broader different skills set, including the ability to develop innovative ways of using technology to enhance the learning environment as well to encourage technology literacy, knowledge deepening and knowledge creation, both to encourage them to experiment with the use of new technologies and to reflect on the impact on teaching and learning processes. Recently, the debate on teachers' professional development and training in the use of ICTs (Polly et al., 2010) has been enriched by the so called TPACK model (Technological Pedagogical Content Knowledge, Koehler &Mishra, 2008), which emphasizes the importance to consider the complex interaction among three types of knowledge: Content, Pedagogical and Technological. The model stresses the opportunity to jointly develop each of these teachers' knowledge, keeping them constantly linked, since this is the best way to promote a gradual and effective acquisition of the necessary skills to teach in a new and innovative way (Koehler et al., 2007).

Such framework sets the background for the Italian Plan for the diffusion of Interactive Whiteboard (IWB), a government program for teachers' professional development aimed to develop and to improve the educational practices innovation through the diffusion and the use of Interactive Whiteboards in Italian primary and secondary schools (MIUR-ANSAS, 2010). The Plan is a part of the wider "Digital School" Project and it aims "to ensure schools the opportunity to adopt innovative teaching and learning methods", as well as to "develop and strengthen educational innovation through the use of information technology". To reach such objectives, the Plan has realized specific teachers' training initiatives aimed to promote the integration of IWBs in innovative educational practices; since 2009, the Plan has involved over 30.000 teachers of primary and secondary schools in all Italian regions. The assumption underlying the Project is that teachers' professional development is an essential condition to favor the shift from the mere adoption of IWB in the schools to its significant integration in educational practices (Wood & Ashfield, 2008; Biondi, 2009).

In the last decade, in European and International contexts, have taken place a growing number of specific initiatives aimed to promote the diffusion of IWBs in schools, as a consequence of the positive impacts of the use of this technology on students, teachers and teaching and learning processes as observed by several studies and empirical researchers (see Becta, 2003, 2006; Balanskat at al., 2006; Thomas & Schmid, 2010). Generally, Interactive Whiteboard appears as an effective educational tool to increase the levels of attention, motivation and engagement of pupils in classroom, as well as to rise teachers' level of job satisfaction improving the educational practices and the relationship between teachers and pupils, in particular due to an increasing level of interactivity (Higgins et al., 2007; Moss et al., 2007; Gentile & Pisanu, 2012).

III. RESEARCH OBJECTIVES AND METHODOLOGY

The article focuses on the last edition of training course addressed to early secondary school teachers (over 18.000 enrolled) presenting the main results of monitoring and evaluation activities related to the Italian "Plan for the diffusion of Interactive Whiteboard". The research has aimed to verify the Plan's effectiveness in promoting IWB's adoption by teachers in educational practices and to analyze whether its use has implied significant changes in teaching and learning processes. The objective was to investigatethe main modalities in which teachers have used IWB in classroom and their perception of the impact on students, analyzing if, and at what extend, the Plan has lead to a transformation in their professional behaviors. The aim was to provide empirical evidence to identify some weak points towards the development of innovative educational practices and improvement factors to remove or, at least, to reduce them.

The article reports teachers and e-tutors evaluation and consideration on training course experience, basing on data collected trough focus groups. Particularly, e-tutors have played a core role in training path, by evaluating teachers' educational needs and supporting them in carrying out innovative teaching practices. Thus, their point of view allows to understand if, and at what extend, teachers involved in the course experienced greater impacts on their professional development, becoming able to enhance ICTs skills reflecting on teaching methods and practices.

Considering that course's participants were dislocated in different Italian regions, the research has used in a complementary way in presence and online focus group. This has allowed to involve a more extended sample, since the online setting has guaranteed a wide geographical covering, moreover implying significant time and resources (economic and human) saving. Teachers have been interviewed trough in presence focus groups, realized inside the schools, while e-tutors have been interviewed online. More in detail, in both cases, the subjects invited to participate in focus groups have been selected taking into account three selection criteria in the sampling design. The first one refers to the representativeness of all geographical Italian areas, so that two in presence focus groups are realized in the North (Turin and Genoa), two in the Centre (Massa Carrara and Rome), and two in the South (Foggia e Naples) of Italy. According to the same criterion, e-tutors selected for online focus groups have played their role in schools of different regions all around Italy. The other criteria refer to gender and teaching discipline: on this last point, the selected participants have been equitably teachers of Humanistic and Scientifics disciplines, as well as e-tutors of respective areas. Subjects selected in such way have been invited to participate to focus groups trough e-mail, communicating location (just in presence focus group case), date and time. The six in presence focus group have involved 40 teachers (on the average, six participants for each focus group), the four online focus groups 25 e-tutors (on the average, six participants for each focus group). In particular, online focus groups (Fielding et al. 2008) have been realized trough videoconference system provided by Breeze platform, a web meeting application that allows video and voice recording. They have been conducted in synchronous modality, allowing participants, under the researcher "moderator" guide, to take part to the discussion in real time, integrating oral and written communication by microphones and chat. The platform's previous knowledge by e-tutors, gained in the same training course to manage online meetings with teachers, has avoided problems connected to its use and has favored a profitable exchanging ideas among participants.

IV. RESULTS AND DISCUSSION

IWB's innovative aspects in educational methods and practices

A specific research's focus has been set on the innovative elements associated to the use of IWB in the classroom and the related resulting changes in teaching and learning processes. On this point, the opinions expressed by teachers and by e-tutors seem to be very similar.

First of all, the use of Interactive Whiteboard has implied a radical change in teaching methods and strategies, leading to the shift from "traditional" frontal lesson, where teacher exposes contents and themes while students listen and take notes, towards lectures where students are more involved in classroom activities. This has been related, mainly, to the IWB interactivity feature: the opportunity to physically interact with the surface of the board, trough hands, pens and highlighter tools, moving and dragging an object from one place to another around the screen, as well as the ability to use photos, sounds or videos and interactive simulations into a lesson, are all aspects that could radically change the dynamic of how teachers lecture and students learn. In particular, the IWB multimedia features allow to use different functions that could make lesson more interactive. Among the several opportunities, interviewed teachers have referred the following: the contextual and immediate surfing the net to deepen specific topics, the screen personalization, the use of e-books, clouds and conceptual maps, interactive exercises, as well as of tools like pen, rubber and colors to modify contents. All such features have attracted students and the main method assumed by the majority of teachers has been to invite them to the IWB, in order to physically interact with it. This has implied higher degree of attention, motivation and involvement, representing added values in terms of skills' acquisition and socialization processes, confirming Interactive Whiteboard as "an authentic knowledge assembling table, where teacher and students act and interact to generate new knowledge" (Biondi, 2009). Although such positive impacts of the use of IWB' use have been observed on all students, a lot of teachers highlighted particular advantages for difficult students, like those with learning disabilities or special educational needs. Such positive impacts have represented an important incentive for teachers to continue to experiment new teaching methodologies and practices.

On the other hand, it has been noticed a significant change in the way teachers organize lectures' materials: the use of IWB, due, in particular, to the opportunity to save contents, has allowed them to keep track of the done work, modifying it successively or sharing it online with all students. This has implied teaching materials' managing time saving, providing the opportunity to collect all the materials in specific repository and "database" that can be consulted everywhere and anywhere.

It has to be noted, however, that a lot of e-tutors have reported some doubts related to the fact that the introduction of IWB in the classroom has leaded to a real innovation in teaching methods and practices. Some of them have affirmed that a lot of teachers have just tried to improve their ability to use IWB, without, however, calling their "traditional" lessons in question, i.e. without really chancing the organization of their teaching activities. Thus, a lot of e-tutors recognized that the introduction of IWB in the classrooms has represented a potential dawn for innovative processes development in schools, but they don't consider them fully completed. In particular this could be connected to two different aspects that have influenced IWB's adoption and use by teachers involved in the "Plan". These two aspects will be analyzed in the following pages.

Teachers and IWB: between digital competences and "cultural" issues

A belief shared by teacher and e-tutors is that individual predisposition and behavior, as well as the previous digital competences influence in a significant way the use of technological instruments. Thus, the Plan seems to have promoted the IWBs' adoption towards really innovative teaching practices just in those teachers particularly oriented to use ICTs in the classroom, recognizing them effective educational tools. The Interactive Whiteboard has been welcomed with great enthusiasm by such teachers, defined by their e-tutors as "mind 2.0 teachers", but has created skepticisms and doubts in others, generally expressing perplexities on the potentialities of the use of ICTs in teaching and learning processes. Such differences among teachers could be connected to two main aspects. The first one refers to a dimension that we could define "cultural", which marks the dividing line between "traditionalists" and "innovators": the latter ones are teachers well disposed to welcome new tools or methods potentially changing their professional activities, while the former ones are less opened to innovation and changes in their teaching processes and routines. In other words, this refers, at an individual level, to what in the first paragraph we have defined as *Propensity* at a firm level. It is clear that, in education contexts, the teachers' "cultural" acceptance or rejection of innovation plays a key role, highly influencing the positive or negative results of innovative initiatives.

On the other hand, we have to remind a second important element differentiating teachers involved in the Plan, i.e. their different technological competences. Even if all teachers were novices in using IWB, being for them the first approach to the tool, those with more familiarity with the use of new technologies have felt themselves more loose, more inclined to experiment IWB's teaching potentialities. The others have expressed a feeling of incompetence in front of the tool, feeling clumsy and experiencing a lot of difficulties in using it. Most of them have indicated, as one of the main weaknesses of the Plan, the choice to address the same training course to teachers with different digital competences. They have instead highlighted the need to differentiate training paths taking into account previous participants' technological skills and competences, so that the opportunity to distinguish between teachers needing "computer literacy", i.e. "digital ABCs", and those at higher knowledge and competences' levels. Teachers and e-tutors have agreed the acquisition of technological skills, connected to tool's use, is the required prerequisite to proceed in the teaching deepening, optimizing all the tool's potentialities in educational settings.

As pointed out by Tosi (2010:17-18) "...needed time to become familiar with the new technology, to master it in the social context of the classroom as well as to explore and to experiment

its potentialities is quite long (1-2 years). Thus, a training path introducing in the first phase innovative methodological approaches when teacher is unable to master the technology is ineffective…during the first steps teacher will appropriate the new functions by adapting the technology to his/her previous methodological approach, till to then develop their potential in a creative sense when obstacles and barriers to the use are at least partly overcome".

Interactive Whiteboard in the classroom: different use and competency levels of teachers

The aforesaid considerations on individual predisposition and behavior in front of technological instruments and on digital competences and skills introduce a detailed analysis of how Interactive Whiteboard has been used by teachers in classroom. In the majority of the cases, interviewed teachers and e-tutors have reported some difficulties to fully optimize the potentialities provided by tool, i.e. to apply them into teaching practices. Often, teachers tend to reproduce the "traditional" frontal lesson: the IWB' s interactivity features are used very rarely, since just teachers use the Interactive Whiteboard, touching its screen and working on it, while students stay seated. Generally, IWB is used as a video/slide/PowerPoint projector and active engagement by students is lacking. On the other side, multimedia opportunities seem to be more used but, again, just by teachers and not by students, nor in shared ways: the activities more frequently acted are moving objects, graphs and figures on the screen, surf the web to search information, watching videos and listening songs.
Thus, such very basic IWB's use leads generally to replicate traditional teaching practices, showing the difficulties in developing innovative educational processes through technology that involves, instead, a thorough renewal of the way we use and produce information and knowledge (Kampylis et al., 2012).
In other words, the majority of teachers involved in the Plan has used the Interactive Whiteboard in a way that could be connected to the first level of performance identified by Haldane and Somekh (2005), i.e. "Foundation" level: "at this level teachers are using the interactive whiteboard primarily as a presentation/projection tool for presentations, videos etc. They are most frequently positioned next to the computer itself, using the mouse and keystrokes to manipulate what is seen. They may make forays to the board to write with the electronic pen but if an old whiteboard is still in situ, or a flipchart is available, they are likely to utilize these". The higher levels identified by the authors imply growing confidence with IWB's use and greater frequency and facility in mastering its interactive functionalities, till to reach high levels of creativity and to become "true virtuoso performers", exploring new educational potentialities. From the description provided by teachers and e-tutors of our samples of the actual IWBS' use in the classroom, very few cases in which IWBs were used with high confidence and competenceshave emerged. Even if some teachers were used to invite students to utilize the board directly (level 2, *Formative*, in Haldane and Somekh's framework), and others to use specific software tools (level 3,*Facility*) to reach particular educational goals (especially in disciplines like Math, Science and Geography), we have observed a very scarce propensity to explore "new horizons", becoming "hunter-gatherers, actively seeking out and harvesting new ideas, new content, new useful Internet sites" (level 4, *Fluency*), nor to "demonstrate the confidence and ability to adapt and improvise in response to students' signs of interest or difficulty" (level 5, *Flying*). A strong interconnection between IWB's use and teachers' technological skills has clearly emerged, as well as the influence of their predisposition and belief on tool's educational effectiveness. So, from one hand, as just noted, low technological skilled teachers have encountered significant difficulties in reaching a good level of confidence with tool's use that have compromised their opportunities to optimize the IWB's additional functionalities, limiting their use to the basic functions. From the other hand, skeptical teachers have often showed what we've called "cultural resistance" to innovation: not conceiving IWB as an educational tool potentially improving teaching and learning processes, they have appeared "reluctant" to use frequently it in the classroom, as well as to experiment its functionalities, preferring, instead, to continue to use "traditional" teaching methods and practices.

V. TOWARD THE DEVELOPMENT OF TECHNOLOGY-BASED SCHOOL INNOVATION: WEAK POINTS AND IMPROVEMENT FACTORS

At the end of focus groups with teachers and e-tutors we've asked them to indicate the main experience's weak points regarding the opportunities to develop innovative educational practices in their schools and to suggest improvement factors to remove or, at least, to reduce them. The collected weak points could be categorized into three categories.
The first one refers, in a broad meaning, to teachers and it implies two just mentioned dimensions, i.e. the low technological competences owned by a lot of teachers and the "cultural" resistance of "traditionalist" teachers. In relation to the first aspect, interviewed have underlined two opportunities that would be taken into account in planning and realizing future training activities in order to address them to a specific and appropriate target: a) verify that the needed technological skills and competences are actually owned by all teachers involved and, if not, plan the opportunity to realize *ad hoc* courses to provide teachers with them; b) address training initiatives as the Plan just to already high technological skilled teachers. Even if the latter opportunity could imply a serious risk to sharpen the existing digital divide in school, increasing the gap between low and high technological skilled teachers, it could represent a reasonable suggestion, considering the lacking of education systems' financial resources, especially within the present economic crisis, that makes impossible to plan and realize a more large-scale ICT's familiarization initiatives. Regarding the "cultural" resistance issue, interviewed subjects have highlighted, first of all, the lacking of an "innovation culture" in education sector, that should be more encouraged and diffused mainly at political level in order to make clear the opportunities associated to it, making educational innovation practice the norm, not the exception. Secondly, it has been underlined the potential positive effects of planning collaborative activities where higher technological skilled teachers and more open to ICT innovation could clearly demonstrate to others "more reluctant" the advantages of new educational technological solutions and practices.

The second weak point's category refers to what could be defined "school level barriers" (Eurydice, 2011), including, in particular, inadequate technological infrastructure and the lack of technical support inside the schools. Regarding the first aspect, interviewed have agreed in considering inadequate the ICTs equipment in schools, from both quantitative and qualitative point of view. The number of available IWBs has shown insufficient to cover all classes' demand, so that each school have been compelled to decide where to collocate the Interactive Whiteboard in the building. Some have chosen to put it just in the first year class, excluding from its use students attending the second and third years classes. Others have decided to provide each school's section with an IWB, planning an in rotation use, with fixed scheduled days, moving students from their classes to the IWB equipped class. Finally, others have opted to put IWB in laboratories or in special rooms, as libraries or reading rooms, whose fruition was dependent on previous booking. The different solutions adopted due to the insufficient IWBs availability have lead to some broader reflections connected to the start and development of actual educational innovative processes. The impossibility to put the Interactive Whiteboard in each school's classroom and the "forced choice" to put it in special rooms, especially in the "traditional" technological laboratories, have tended to replicate an "old school" logistic organization, spreading the ICT image as tools that have to be used *ad hoc*, just for specific and contextualized activities. This seems to be exactly what the Plan, and more generally the latest European directives, would have avoided, promoting, instead, an "ICTs naturalization", i.e. their gradual but constant use within daily educational activities performed in the classroom. To this, it has to be added the frequent tool's technological problems and malfunctioning, as well as difficulties in Internet connectivity: often, teachers, especially the less technical skilled, have panicked if something was wrong, with evident negative consequences in terms of teaching practices effectiveness. This leads to underline another weak point indicated by teachers and e-tutors, confirmed also by other researches (Korte & Husing, 2007), i.e. the absence or ineffectiveness of technical assistance provided by specific available professional profiles working in schools. The frequent technological equipment-related problems and their inability to solve them often have discouraged teachers from using IWB in their teaching.

The last weak points category includes elements referred to teacher professional development training course. In particular, interviewed have focused on two aspects. First of all, they have underlined the opportunity that teachers involved in professional development activities should be more "valued" within schools, trough economic or other forms of incentives (some of them, for example, have complained a scarce acknowledgement by headmaster). This has been understood as a degradation and flattening of their professionalism: the majority of interviewed have stressed the need to receive more acknowledgement for teachers' great deal of effort towards the innovation of their teaching methods and practices, as well as for their workload needed by IWB. Secondly, one of the main obstacles to the diffusion of innovative educational practices refers to the occasional/sporadic frequency of ICTs-based teacher's professional development initiatives. With specific reference to the Plan, interviewed subjects have complained the lack of a continuous support and coaching path for teachers ending the training course. Often, as noted by some of them, the starting of the innovation process has been registered during the ending months of training experience, but this has also lead to an abrupt stop at the end of the course: in other words, teachers have perceived of having been left alone with themselves, without any kind of support. For a lot of them, this has compromised training experience's quality and, of course, this has represented a serious obstacle to a potential evolution in terms of educational innovation.

VI. CONCLUSION

The article, starting with a review of the different ways in which the concept of innovation could be conceived in education sector, has focused on technology-based school innovations and the potential role of ICTs for economic and social development in the actual knowledge economy. The proposed evaluation case study has focused on an Italian early secondary school teachers' experience in using Interactive Whiteboard in classroom in order to identify factors facilitating the arise and development of educational innovation, as well as barriers to an effective IWB adoption in schools. First of all, it has to be emphasized the crucial role of teachers to ensure the promotion of education systems' innovation through the use of new ICT tools. As any other professional profiles, teachers have different behaviors towards new technologies, so that their personal "propensity" and "cultural" acceptance or rejection of ICTs innovation plays a key role in producing positive or negative results of innovative initiatives. Thus, even if IWB could potentially have great opportunities to innovate educational methods and practices, there is the risk to assist to its underuse, from a quantitative and a qualitative point of view, that is regarding both its frequency use, both the employ just of its very basic functionalities. This leads to conclude that to equip classroom with an IWB (equally to any other ICTs) is not enough to innovate teaching and learning practices, nor to "revolutionize" schools. In order to optimize all the IWBs potentialities it is necessary an active teachers' engagement (Celik, 2012) and we agreed with Higgins et al. (2007:217) saying "good teaching remains good teaching with or without the technology; the technology might enhance the pedagogy only if the teachers and pupils engaged with it and understood its potential in such a way that the technology is not seen as an end in itself but as another pedagogical means to achieve teaching and learning goals".

It has to be underlined, however, that teachers involved in our case study were at their first experience in using Interactive Whiteboard, so this could explain the registered generally low IWB's competence level. As emerged by focus groups, suitable further training is needed to make them able to exploit all educational potentialities an Interactive Whiteboard has to offer, as well as adequate ICT-based professional development opportunities, including continuous coaching in IWB's use in the classroom, also after the end of training activities.

Besides, this case study has showed again how innovation is extremely context-dependent, considering both internal school characteristics, both external environment in which each school

is embedded. Regarding the first aspect, the research has highlighted how inadequate technological school infrastructure features could represent serious obstacles to innovative processes development. With respect to the second aspect, a growing institutional effort in term of educational policies is needed, trough focused initiatives, in order to fill what interviewed called "the lack of an innovation culture" in education sector, as well as to make ICTs not just annex tools to "traditional" educational practices, but to attribute them a more specific and time constant role in educational settings (Bottani et al., 2011).

In order to capture a more comprehensive investigation of technology-based school innovations, we would like to stress the opportunity to jointly consider different education systems levels, since just their combined analysis may lead to better analyze the innovative potentialities of ICTs diffusion, distinguishing the influences of new technologies from other possible influences associated with context and individual variables (Cox & Marshall, 2007; CERI, 2010). Thus, the levels to consider should include: the social, political and educational context, including the educational policies promoting the adoption and the diffusion of ICTs in schools trough effective initiatives; teachers, for example, competence in using technology, training background in using technology, methods of teaching and class management, aims in using technology; technology, i.e. devices and tools, as well types of technology; school, focusing on technological infrastructure, organization of learning environments, available space and rooms. Other two dimensions, less analyzed in the article, have to be added. One is referred to "student level", considering, for example, competence, frequency in using technology, gender, social-economic status or family background, psycho-social constructs like motivation or self-efficacy (Gentile & Pisanu, 2012). The other refers to "external relations", concerning the engagement of different stakeholder (such as students, parents, labor market representatives and community) in student learning, decision making participation as well as marketing practices (OECD, 2010b).

To conclude, more researches are needed to deepen how the structure of school systems as well as the different education systems levels could promotes or inhibits different types of innovation, in order to identify further improvements factors in educational policies, optimizing, especially in the light of the actual financial crisis, the use of funds to improve technology-based school innovation (Pedrò, 2010). Indeed, a careful attention has to be paidto the translation process from the starting of innovation to its implementation, since "change in education is easy to propose, hard to implement and extraordinarily difficult to sustain" (Hargreaves & Fink, 2006).

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