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Making the School Smart: The Interactive Whiteboard Against Disparities in Children Stemming From Low Metacognitive Skills

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Abstract

The demand for an increasingly differentiated education, which takes into account the individual differences of children to stimulate effective learning, accompanies the introduction of new technologies at school. Amongst these, the Interactive Whiteboard (IWB), which allows multimodality and sharing of contents, is one of the most widespread tools in schools. The aim of the study was to test with a sample of primary school children the impact of a teaching session with the use of the IWB (vs. traditional lessons) on knowledge performance. In addition, we were interested in investigating the role of metacognition as a potential moderator on learning effects. Our results revealed an advantage of IWB use in learning achievement. Notably, the increase in learning outcomes only occurred among children with low metacognitive skills. This shows that new technologies can play an important role both per se and in supporting learning processes, especially of less metacognitive students, therefore contributing to reduce the gap between children with differential metacognitive skills. The results are analyzed in light of the important role in the nowadays world of Information and Communication Technologies, which can become an extremely relevant and appealing educational and cultural compensation tool.

KEYWORDS: ICT, metacognitive learning, IWB, smart teaching

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1. Introduction

Recent years witnessed the emergence of increasingly differentiated educational needs. The school should, therefore, be able to offer children a range of educational opportunities, involving the use of different languages, modalities, and supports. A tool that is acquiring growing importance in everyday life, and in schools, is represented by new technologies, that allow the possibility of making use of animations and videos in interacting with dynamic environments and in which the child can be a passive spectator as well as an active participant. With new technologies, knowledge should not be conceived as pre-packaged instructions or concepts to be transmitted; instead, it can be a joint construction of teachers and children (Solomon, 1993; Tucci & Antonietti, 2009). Digital devices offer the possibility of increasing the centrality of students by transforming the traditional classroom environment into a student-centered collaborative environment and bringing the school closer to communicative and learning forms typical of the so-called ‘digital natives’ (Prenksy, 2001; Somyürek, Atasoy, & Özdemir, 2009).

ICT can allow teachers to create opportunities in which students can learn by doing, helping them visualize difficult-to-understand concepts (Mouza, 2005). Clements and Nastasi (1993) argue that, in addition to promoting children’s learning, technology can foster social interaction, peer teaching, and collaboration.

Nowadays, a revision of the curricular contents and an adaptation of the knowledge in order to respond to the characteristics and demands of children and society is crucial (Herrington & Kervin, 2007; Silva, 2009). It is important to present students with authentic tasks (Jonassen, 1992), namely meaningful, contextual tasks, which have adequate levels of complexity, relevance and usefulness in everyday life. Introducing the new technologies in the school provides the opportunity for change, not only at the ‘practical’ level of educational tools to manage learning processes and teaching.

Instead, change can allow to reflect on these processes and innovate them consciously and critically.

The reforms that led to the massive introduction of Information and Communication Technologies (ICT) within our classrooms are causing a significant change in the world of education. ICT can become potential agents of change capable of influencing the educational setting, which includes physical environment, behaviors and relationships between the various actors, tasks and activities, relational and operational climate, motivations and expectations (Carletti & Varani, 2007). This change is increasingly directed at moving away from the exclusive use of traditional teaching, understood as teaching that uses paper material and in which knowledge is presented in a standardized way. Teaching should be able to use and integrate these new technological tools, shifting the focus from the school system to the individual.

The full potential of technology is realized when it improves the effectiveness of a learning environment, when it supports profound and meaningful learning, and when it realizes an active, constructive, collaborative, authentic, and intentional teaching approach (Jonassen, Howland, Marra, & Crismond, 2008; Scardamalia & Bereiter, 2006). ICT should not be understood as 'teaching machines', but as a 'tool' that allows the student to co-construct his/her own learning path, to socialize it and therefore to personalize it with respect to personal cognitive styles (Battro, 2010; Rivoltella, 2008). In other words, it is not sufficient to introduce ICT in the school and use them as traditional tools. Instead, ICT should match the characteristics of the individual, and favor an active and efficient learning process. The challenge, therefore, does not concern the introduction of ICT per se, which is quite straightforward. Instead, it relates to the ability to use ICT to stimulate students and their learning process as efficiently as possible, taking advantage of their potential and allowing them to overcome their learning weaknesses.

2. ICT and metacognition

Technological tools can facilitate taking awareness of one's own mental processes. In this sense, these tools can make visible and concrete the choices, the mental associations and the operating procedures that characterize students' psychological processes (Tondeur, Van Braak & Valcke, 2007; Varani, 2007).

Indeed, the reflection on one's own mental processes while learning is a key element of metacognition. Metacognition is defined as the learners' knowledge of their own cognitive processes (Dignath, & Büttner, 2008) and mental functioning (Flavell, 1979), that is what one knows about how his/her and other people's minds functioning. It also refers to the different forms of control that can be implemented before, during and after the execution of a task (Brown, 1987), namely planning how to approach a task, anticipating how successful it will be, choosing the right strategy, assessing progress and, if necessary, selecting different and more appropriate learning strategies.

The interest generated by metacognition is largely due to the fact that it is considered a powerful predictor of the learning performance of children (Roebers, Krebs, & Roderer, 2014). Although not numerous, there are studies that investigated the role of metacognition and ICT in learning environments (see Cadamuro, Bisagno, Pecini, & Vezzali, 2019 for a review). The literature reveals evidence that metacognitive skills can facilitate learning in environments characterized by new technologies (Ramirez-Arellano, Bory-Reyes, & Hernández-Simón, 2019; Wall & Higgins, 2006).

Technological tools can be an important support for metacognitive reflection because they allow recording the actions performed by the individual, therefore providing the student with 'personal' feedback, which is a response about the physical and conceptual operations s/he actually performed (Mercer, Hennessy, & Warwick, 2010). Moreover, new technologies allow asking the student questions about his/her own cognitive activity with the aim to increase monitoring and making this reflective attitude a habit when facing learning tasks (Antonietti, 2011). Some technological tools can encourage and support social interaction and cooperation, indirectly favoring a 'distributed' and shared metacognition. For example, discussion, comparison and conversation are excellent tools to raise awareness about the mental processes involved in an activity (Antonietti & Colombo, 2008). Therefore, new technologies can be used to support the development of metacognition, by helping students manage information in different ways, improving their way of taking notes and organizing their learning.

In line with the aforementioned studies, the review by Cadamuro et al. (2019) highlights that ICT and metacognition are in a bi-directional relationship, exerting reciprocal influence on each other. Importantly, this review also highlighted a theoretically more interesting and challenging result, that is e-learning environments can have beneficial effects on learning outcomes when they are structured in a way to take advantage of metacognition. In particular, when individuals are provided metacognitive guidance, they are better able to take advantage of ICT, with resulting benefits on the learning performance (Kramarski & Gutman, 2006). In other words, ICT and metacognition can jointly contribute to defining the optimal psychological processes relevant to learning. Indeed, students with better metacognition take advantage of more effective skills and strategies when using technologies. Metacognition, therefore, supports the individuals' awareness with respect to the knowledge and skills that are necessary to achieve certain goals, where to focus the attention and where to adjust efforts.

However, what happens when ICT is introduced without ad-hoc metacognitive training that can optimize their use? Are there generalized learning benefits due to the use of ICT, or these learning benefits will eventually be shown only by individuals with certain metacognitive characteristics? In other words, which is the outcome of the interplay of ICT and individual metacognition skills on learning? Finding this is precisely the aim of the present study. To do so, we focused on a widespread ICT tool in schools, that is the Interactive Whiteboard (IWB).

3. The Interactive Whiteboard in classrooms

The use of IWB in schools has increased in recent years all around the world (Šumak, Pušnik, Heričko, & Šorgo, 2017). The IWB represents an opportunity for easy and immediate use of digital technologies in class (Betcher & Lee, 2009), a consideration that has contributed to increasing its popularity amongst many teachers (Murcia, 2014). IWBs were regarded as one of the most revolutionary instructional technologies for different educational levels (Türel & Johnson, 2012). They can offer several pedagogical benefits such as facilitating the integration of new media, enhancing the interactivity, fostering learners' engagement in lessons (Koenraad et al., 2015), and dialogue (Dostal, 2009; Kerawalla, Petrou, & Scanlon, 2012).
Students and teachers generally perceive IWB as a positive addition to the classroom learning environment (Hall & Higgins, 2005; Manny-Ikan, Dagan, Tikochinski, & Zorman, 2011). In line with this trend, the IWB has been spreading over the last few years also in Italy, mainly because of the massive national and local investment plans that have made it an important part of the digitalization process of Italian schools.

During the second half of the '90s, Italian ministerial policies proposed the "Didactic Technologies Development Programs" [Programmi di Sviluppo delle Tecnologie Didattiche], in which ICT were introduced to facilitate active and cooperative work and to reduce the gap between the class and school and the outside world (MIUR, 1995). In 2002, the "National Plan of training of teachers on information and communication technologies" [Piano nazionale di formazione degli insegnanti sulle tecnologie dell'informazione e della comunicazione", ForTic] was proposed with the aim of promoting technical knowledge but also an effective use of technology. In 2007, the "National Digital School Plan" [Piano Nazionale Scuola Digitale, PNSD] was launched to promote new practices and new learning models. The plan passes through three main initiatives: the IWB action, which provides funding for the purchase of interactive multimedia whiteboards and the related training of teachers; the Cl@ssi 2.0 action, which aimed to assess the effective integration of technologies in schools with a shift of focus to the effectiveness of technologies in changing contexts and learning processes; and the Digital School Publishing Action, which aims to transfer teaching resources from paper to digital format, with the possibility for students to edit, comment, and interact with the text. In 2016, the PNSD, within the reform of the School [La Buona Scuola], aimed to guide schools on a path of innovation and digitalization and introduced ICT in schools, spreading the idea of lifelong learning and extending the concept of school from the physical place to virtual learning spaces. According to the findings of the MIUR Technological Observatory, in the 2014-2015 school year, 70% of the classes were connected on-line and 41.9% were equipped with an IWB (MIUR, 2015). Currently, in Italy, the IWB is a very common tool. It is estimated that there are about 70,000 IWBs. The wide spread of the IWB in the classroom is due to its potential to encourage collaboration by creating a shared learning environment suitable for teaching strategies with either the whole classes or small groups (Bennett & Lockyer, 2008). The IWB can also create new opportunities for students to learn through multimedia or interactive resources (Alvarez, Salavati, Nussbaum, & Milrad, 2013; Gillen, Littleton, Twiner, Staarman, & Mercer, 2008; Wall, Higgins, & Smith 2005).

Since the large-scale introduction of the IWB in schools, there has been an extensive body of research on its educational uses. Researchers primarily focused on two aspects of the IWB use in schools: IWB as a tool that promotes a more effective teaching process, and as a tool that supports students' learning (Morgan, 2012). Many studies have shown that the use of IWB has a positive effect on student learning (Amiri & Sharifi, 2014; Digregorio & Sobel-Lojeski, 2010; Wall et al., 2005; Warwick, Mercer, & Kershner, 2013). The literature suggests that the IWB offers the opportunity to better match learning to different student learning styles (global, local, visual, verbal, etc.) and this allows teachers to customize teaching according to the individual characteristics of the students (Wall et al., 2005). Therefore, it can help teachers in meeting students' diverse learning needs and provide more opportunities for interaction and discussion in the classroom, also when compared to other ICT (Luo & Yang, 2016; Smith, Higgins, Wall, & Miller, 2005). The use of IWB also brings some significant changes in the teaching process in terms of time-saving for teacher's preparation of the teaching material, saving of the prepared content for later re-use, rapid transitions within and between the presented contents, fast retrieval of already displayed content, thus enabling a teacher to respond to students' needs in case of comprehension difficulties (Bennett & Lockyer, 2008; Cutrim Schmid, 2008).

Students, on their side, have a positive perception of the IWB, to the extent that it can motivate learning and make lessons more enjoyable (Balta & Duran, 2015; Glover, Miller, Averis, & Door, 2005; Şad, & Özhan, 2012; Smith et al., 2005; Wall et al., 2005). Indeed, the visual appeal is noted as one of the main contributors to motivation (Smith, Hardman, & Higgins, 2006) and there is a general agreement that the IWB has a positive effect on student motivation (Davidovitch, & Yavich, 2017; Higgins, Beauchamp, & Miller, 2007; Morgan, 2012; Slay, Siebörger, & Hodgkinson-Williams, 2008; Smith et al., 2005). It has also been reported that the IWB promotes students' interest and their sustained concentration (Glover & Miller, 2007).

Therefore, the literature on the IWB generally supports the idea that it can positively impact students' perception, motivation, engagement, attention and learning styles (Fekonja-Peklaj & Marjanovicˇ, 2015).

Finally, the IWB can be a dynamic and manipulative object that supports socially shared cognition, helping students working together (Hennessy, Deaney, Ruthven, & Winterbottom, 2007). Warwick and colleagues (2013) argue that the IWB can promote the development of children's ability to reason collectively and to regulate their joint activities. This peculiarity may improve the quality of the relations between student and teacher, but also among classmates (Glover et al., 2005), increasing the students' disposition to share acquired knowledge and to learn from their own and others' mistakes (Smith et al., 2006).

Despite all these positive effects, some studies found that the effects of IWB aided teaching were weak, invalid, or even detrimental. For instance, Torff and Tirotta (2010) stated that claims about the motivation-enhancing effects of the IWB appear to be somewhat overstated. Luo and Yang (2016) concluded that the usefulness of the IWB and its effects on willingness to learn are not as clear. Fekonja-Peklaj and Marjanovič-Umek (2015), based on the content analysis of teachers' and pupils' answers, reported both positive (dynamic display of the content, pupils' attention and motivation, immediate feedback) and negative aspects of the IWB (technical difficulties, a frontal way of teaching, teacher's lower control over pupils' work). Kervin and colleagues (2010) emphasized that the higher motivation of students to learn with the ICT does not necessarily mean that their motivation is focused on the content, but can instead be directed to the device used by the teacher. Above all, questions remain about the relationship between the IWB, students learning and scholastic achievement. In fact, the literature presented above explored many outcomes related to actors of the educational process. Surprisingly, however, studies examining the impact of IWB on learning achievement are scarce (Bidaki & Mobasheri, 2013; Hockly, 2013; DiGregorio & Sobel-Lojeski, 2010). Indeed, when the connection between the use of the IWB and the students' knowledge performance was explored directly, findings were mixed: while some studies showed a positive effect of the IWB on learning achievement (Chen, Chiang, & Lin, 2013; Maher, 2011; Swan, Schenker, & Kratcoski, 2008; Zittle, 2004), others did not find supporting evidence (Higgins, Beauchamp, & Miller, 2007; Moss et al. 2007; Swan, Kratcoski, Schenker, & van't Hooft, 2010). Clearly, if the IWB has positive effects on the educational process, this should also be found with respect to one of its main outcomes, that is learning achievement.

4. The research

Despite the vast body of research that investigated the educational impact of new technologies, and, in particular of the IWB, some questions remain open. In fact, there still is equivocal evidence with respect to the impact of the IWB (Smith et al., 2005) upon learning achievement. For this reason, we carried out a study with a sample of primary school children, aimed at evaluating the impact of a teaching session with the use of the IWB on knowledge acquisition. In addition to using the IWB, we identified a potential moderator that, as described above, is directly relevant to learning: metacognition. More precisely, an experimental group used the IWB, while a control group went through traditional teaching with the use of a traditional blackboard. Before the lesson, participants were administered a measure assessing their metacognitive skills, allowing us to test their role as a moderator of learning with new (IWB) vs. traditional technologies.

First, we expected an advantage of IWB use, such that performance scores should be higher when using the IWB than when being exposed to the traditional lesson. Our second prediction was that greater metacognitive skills will be associated with better performance in the evaluation test. More directly relevant for our research, based on the literature reviewed, we predicted no difference in learning between participants with high metacognitive skills in the experimental vs. control group. Indeed, individuals with high metacognitive skills should be able to process information more efficiently and to better integrate it with pre-existing knowledge, independently on the instrument by which teaching occurs. In contrast, we predicted the role of the IWB in favoring learning in those with less metacognitive skills, who may be less able to reflect on their mental processes and integrate information with pre-existing knowledge. When using the IWB, however, the characteristics of the tool, including the different channels (e.g., visual, audio) by which information is conveyed, may stimulate individuals in making better use of their scarce metacognitive skills. The variety of channels by which the information is presented can allow integration of information, that, in their absence, is up to metacognition. In other words, using the IWB might buffer the effects of low metacognitive skills on performance, and allow a similar performance of participants independently on their individual level of metacognitive skills. We, therefore, expect an interaction between IWB use and metacognition, such that IWB use (experimental group) will lead to better performance (compared to the control group) only among participants with low levels of metacognitive skills.

4.1 Participants

One hundred and eighty-four Italian children (89 males, 96 females) took part in the study. Participants were enrolled in fourth- and fifth-grade classes from four primary schools located in Northern Italy. Parents provided consent for their children to participate.

4.2 Materials and Methods

To properly compare learning as determined by the use of the IWB, we selected two topics that children had not yet faced in their school curriculum and designed a traditional and an IWB version of them. The first topic related to 'Children's Rights' (Grade 4) and the other to the 'Italian Constitution' (Grade 5). Both lessons were presented either in a 'traditional' type mode, where the lesson was conducted according to a verbal approach using the traditional blackboard (control group) or with a multimedia lesson method via the IWB (experimental group). The pupils of each class were divided into groups of four, with each small group randomly assigned either to the experimental group or to the control group.

Among the activities that we proposed to children, there were stories, nursery rhymes that dealt with children's rights and the Italian Constitution, cartoons, some videos based on the film 'Iqbal, children without fear (2015)' (which is about the story of Iqbal Masih, a Pakistani child who rebelled against child labor), images and documents and videos taken from Unicef, Amnesty International and Save The Children. The lessons in the experimental group were created by taking into consideration some important aspects in order to prevent cognitive overload and fatigue in children:

• the graphic character had to be easy to read and facilitate understanding;

• the concepts had to be expressed through short, simple sentences or via keywords;

• each keyword had to be accompanied by a corresponding image to facilitate reading through two different channels;

• the videos inserted had to be short and not contain too much information.

In the traditional lesson, the contents were presented with the same words used in the experimental group, and the same keywords and phrases were reported on the traditional blackboard; the content of the videos used in the experimental group was reported orally.

One group at a time, all the children attended either the lesson with the IWB or the traditional lesson. In the lesson with the IWB, we used some functions, such as the 'felt pen' function, to emphasize and highlight words during the oral explanation. The same was done in the traditional lesson, where the same words were underlined with chalk or felt-tip pen. Both lessons were presented in the most homogeneous possible way, to exclude confounding variables that could influence the comparison between conditions.

In both groups, (traditional or IWB) at the end of the lesson, the children carried out a small group activity which consisted of describing what fundamental rights, or what type of government, citizens (adults and children of different cultures and religions from Earth) of an imaginary planet should adopt. In order to assess the metacognitive skills of children, before presenting them with the lessons, we asked their teachers (one per class) to evaluate them through the Teachers Metacognitive Questionnaire (Carr & Kurtz, 1991). This instrument is composed of nine items, assessing students' strategic awareness and monitoring. In filling the tool, the teachers had to evaluate on a Likert scale (from 1 to 5 points) each child in their class on items such as: 'To what extent is this child aware that there are alternative strategies?'; 'To what extent is this child aware of how the different strategies can be used?'. For each child, the items were combined in a composite score of metacognitive skills (alpha = .91).

Once the lesson was completed, both the control and the experimental groups were administered (upon agreement with the teacher and taking into account children's Grade) a learning assessment test, that each child performed individually. For the 'Children's Rights' topic, children were administered a multiple-choice test with 15 items; for the 'Italian Constitution' the multiple-choice items were 20. Items were averaged to form for each child an individual index of performance (alpha = .73).

4.3 Results

An independent samples t-test showed no differences in metacognition across conditions, $t(184) = 1.47$, *ns*. In other words, participants presented comparable levels of this ability within the experimental and control groups, therefore making the groups comparable in terms of this variable and allowing us to use it as a moderator.

In line with our first prediction, condition affected participants' knowledge performances: participants in the IBW condition displayed a higher performance ($M = 0.78$, $SD = 0.14$) compared to participants in control condition ($M = 0.73$, $SD = 0.18$), $t(184) = 2.06$, $p < .05$. Therefore, the use of the IWB favors knowledge performance.

In order to test the moderating effect of metacognition in the relation between teaching modality and knowledge performance, a regression analysis using PROCESS macro for SPSS (Hayes, 2013; Model 1) was conducted. Specifically, condition (dummy coded: -1 = control condition, 1 = experimental condition), children's metacognitive skills and the interaction term were included as independent variables. The individual index of knowledge performance represented the dependent variable. All independent variables were centered to the relative mean in order to avoid multicollinearity.

Results showed that predictors explained a significant and high amount of variance of the criterion variable, $F(3, 180) = 59.50$, $p < .001$, $R^2 = .50$. In line with our second prediction, a significant main effect of metacognition ($b = 0.11$, $SE = .01$, $p < .001$) emerged, revealing that higher levels of metacognitive skills were associated with better knowledge performance. This result is consistent with literature showing the powerful role of metacognition in learning, and further reveals the reliability of the instrument and of teachers' evaluations of children's metacognitive skills. Interestingly, when taking into account metacognition, condition was not associated with performance ($b = 0.01$, $SE = .01$, *ns*). In other words, when condition and metacognition were simultaneously included in the regression equation along with their interaction, only metacognition was predictive of performance, revealing that metacognition, more than teaching modality, is especially relevant to learning. This result further adds to the explanatory role and relevance of metacognition.

Results also revealed a significant interaction between condition and metacognitive skills ($b = -0.03$, $SE = .01$, $p < .01$). Supporting our predictions, simple slope analysis (see Figure 1) revealed that condition led to better knowledge performance among children low ($b = 0.04$, $SE = .01$, $p < .01$), but not high ($b = -0.01$, $SE = .01$, *ns*) in metacognition. In other words, being assigned to the experimental group, that is using the IWB, favored a better performance only among individuals with low metacognitive skills, who indeed were those that had more to gain from the use of ICT. Also in line with our hypotheses, Figure 1 shows how performance for individuals high in metacognition is constantly higher, however, the use of IWB reduces the gap between participants with high vs. low metacognition.

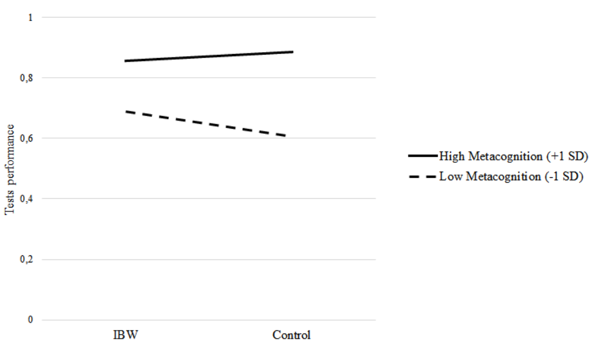

Figure 1. Test performance as a function of condition at high (+1 SD) and low levels (-1 SD) of metacognition.

5. Discussion and Conclusions

The aim of the present study was to test the impact of new technology, namely the IWB, on children's knowledge performance. Importantly, we considered the role of metacognition, that is a psychological variable directly relevant to learning, exploring whether the effect of learning with the IWB depends on children's metacognitive skills.

Our results revealed an advantage of new technologies in learning achievement: children's performance was better when using the IWB than when being exposed to the traditional lesson. This advantage may be due to the fact that, as stated in the literature, the IWB can improve students' motivation (Davidovitch, & Yavich, 2017; Higgins, Beauchamp, & Miller, 2007; Morgan, 2012; Slay et al., 2008; Smith et al., 2005) and promote interest and sustained concentration (Glover & Miller, 2007).

A further relevant finding is that higher levels of metacognitive skills were associated with better knowledge performance. This result is consistent with literature showing the crucial role of metacognition in knowledge performances (Barak, 2010). Interestingly, when considered together, only metacognition (and not condition) was predictive of performance, therefore showing the need to consider this key variable when learning is implied.

However, the most interesting result, both at the theoretical and at the practical level, is that the IWB favored a better performance only among individuals with low metacognitive skills. Students with lower metacognition are, therefore, those that benefited the most from using ICT. Note that students with high metacognition competences performed better in both conditions, but the use of the IWB reduced the gap in performance between participants with high and low metacognition. These less metacognitive students (that is, those who are less able to reflect on their cognitive processes and to regulate them) through the IWB can better integrate, also with the help of different codes (verbal, visual, etc.), the incoming information with that they already have. In other words, the IWB mitigates the detrimental effects of low metacognitive skills on learning and allows a similar performance of participants regardless of their individual level of metacognitive competences.

These results reveal that new technologies can play an important role, especially in supporting and stimulating the learning processes of those students with less metacognitive skills. This finding is consistent with the results of a study that aimed to evaluate the effect of the Flipped Classroom (FC) on learning performance in primary school children (Lazzaretti, Cadamuro, Di Bernardo, Pecini, 2019). The FC was found to be effective in improving learning especially for pupils with low metacognition. Thus, it seems that children with poor metacognition skills are able to make up for their shortcomings because of ICT.

These findings point to the role of new technologies as an educational and cultural compensation tool, that provides students lacking in metacognition with support for processing and memorizing information more effectively. In this sense, a multimedia learning environment allows students to personalize their learning by making the contents close to their learning styles (Wall et al., 2005). Through the use of new technologies, contents can be manipulated and customized, allowing the teachers to respect the different cognitive styles of the students, thus favoring inclusive teaching. The IWB can, therefore, be a tool that benefits both students and teachers if used with sufficient awareness.

Moreover, the IWB facilitates motivation and interaction (Davidovitch, & Yavich, 2017) and promotes an active attitude of students, who become better able to regulate their cognitive and emotional processes. Finally, the IWB can promote knowledge sharing even among peers through discussion and comparison, processes that facilitate students' awareness of their mental processes involved in an activity.

These considerations lead us to recognize the importance of teachers in the effective use of new technologies. Assuming that student achievement will automatically increase with technology use may be wrong and dangerous since it can lead to overly optimistic and unrealistic expectations. Although there are many studies that report positive effects of the IWB when used in the classroom, the IWB effectiveness depends on how it is used by teachers in the teaching process (Kelley, Underwood, Potter, Hunter, & Beveridge, 2007; Polly & Rock, 2016; Türel & Johnson, 2012).

Some studies and reviews have shown that a greater effectiveness of ICT is found when the teacher employs a variety of teaching strategies and offers multiple learning opportunities; when the teacher is trained in the didactic use of the computer and when s/he favors peer learning processes; when optimizing the teacher-pupil feedback; and when the student has the opportunity to take control over the learning process. (Higgins, Xiao & Katsipataki, 2012; Vivanet, 2014).

The IWB has been shown to be an asset to a classroom if teachers are willing to invest their time in learning how to use it with profit. This also includes in some cases changing their teaching style, from more traditional teaching to new pedagogical practices (Celik, 2012; Mercer, Hennessy, & Warwick, 2010) which integrate technology into lesson planning and conducting (Comi, Gui, Origo, Pagani, & Argentin, 2016). Betcher and Lee (2009) reported that teachers generally follow three stages when approaching the use of the IWB. In the first stage, teachers propose the same content using traditional methods. In the second stage, they introduce certain changes but without in-depth alteration in teaching methods, and only in the third stage innovative pedagogy is applied. Many teachers seem to be unaware of the ICT potential in promoting children's learning. This reflects in the use of the IWB as a big visual board or display tool (Kearney & Schuck, 2008), rather than as a learning environment for the co-construction of contents. Teachers with constructivist oriented pedagogical beliefs are significantly more likely to use IWB than transmission-oriented teachers, however, the strongest determinant of usage is whether the technology is immediately accessible or not (Burke, Schuck, Aubusson, Kearney, & Frischknecht, 2017). In fact, the IWB can be perceived as easy to use, interactive, immediate, visual and matching the students' digital culture. However, some authors argue that this effect may be due to novelty that any new ICT can bring, and may decrease over time when learners become used to the technology (Kearney and Schuck 2008; Mariz, Stephenson, & Carter, 2017; Slay et al., 2008), especially if teachers do not know how to integrate this methodology into didactic proposals that stimulate reflection and metacognitive monitoring.

Our results help to address this debate, showing that the effect of the IWB may be related to psychological processes relevant to learning (i.e. metacognition) rather than to novelty. Future studies should, therefore, explore how both aspects (metacognition and novelty), independently or interactively, contribute to qualifying the effect of the IWB.

From an applied point of view, the results of our research confirm the need to use ICT to encourage deeper and dialogic interactions in which pupils articulate their thinking and reflect on their learning. ICT provides the opportunity to create stimulating learning communities and to foster the growth of metacognitive reflection, given that metacognition develops also because of social interaction. The introduction of new technologies brings the opportunity for the school to get 'smarter and smarter' because it leads to reflect on the processes of the learning-teaching process and on how to consciously and critically innovate it.

To conclude, our study shows that the IWB serves who needs it more, that is individuals with fewer competencies to take advantage of a traditional lesson. If this result will be replicated, it will support the important role of ICT in modern teaching, that is providing all children with the possibility to learn how to learn, ultimately improving their school performances and more generally life achievements. Finally, given the role that ICT has in supporting those who need it the most, new technologies represent a promising tool in the fight against educational poverty.

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