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The application of interactive whiteboard technology in general education and English Language Teaching (ELT): A literature overview

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Abstract

This paper outlines the literature on Interactive Whiteboard (IWB) technology in the educational context beginning from its introduction in the 1990s up until the present. Firstly, the historical development of the research is summarized and, secondly, the potential benefits of IWB technology in teaching and learning, as far as most school subjects are concerned, are discussed. For the purpose of this paper, the advantages of IWBs in education have been divided into two categories, that is, the teachers' and the learners' perspectives. To begin with, the issues concerning the advantages of IWBs in teaching, that is, flexibility and versatility, interactivity, and numerous affordances that may provide the potential for pedagogy transformation, are presented. The subsequent sections serve as an analysis of opportunities which are offered by IWB technology and which are especially appreciated by learners. These include IWB visual appeal, the capacity to create a student-centered learning environment and improve motivation, the ease of sharing materials, and others. In practice, the use of the technology may also be hindered by numerous factors and the section that follows touches upon the pedagogical and technical challenges of IWB technology for both teachers and students. Last but not least, the paper includes an analysis of research on IWB affordances specifically applicable in the context of language classrooms and an analysis of IWB-based language classrooms from different SLA perspectives.

Keywords: ICT; information and communication technology; English Language Teaching; IWB; interactive whiteboards

1. Introduction

For the past few decades, we have witnessed dramatic technological developments in all fields of life, including language education. Computers and other sophisticated technological tools have been employed in classrooms incrementally and are bringing about numerous improvements. Davis (2002) illustrates the vertiginous pace of the introduction of technological innovations into education, listing the following devices that have appeared in his language classroom since the 1950s: radio broadcasts, movie projectors, record players, slide/filmstrip projectors, tape recorders, television, overhead projectors, language labs, videocassette recorders, computers, audio CDs, a satellite television, videodisc players, CD-ROMs, the Internet, DVD-ROMs, DVD-Video players, and Interactive Whiteboards (IWBs). The IWB technology is one of the most recent innovations introduced in schools with huge financial support from policymakers in Europe and beyond. However, the technology itself is very costly and its implementation in a generally underfunded field of education needs a robust and scientifically confirmed justification. Hence, the intense development of research on the deployment of IWBs in schools and the added value they bring into the classroom needs analysis. The purpose of this paper is to present a review of literature on the efficacy of IWBs in specific school subjects, with a special emphasis on foreign languages. A discussion of the research on IWB benefits is carried out from teachers' and learners' perspectives. Since in the research activities, reports, and articles analyzed below, these two perspectives often overlap, the division line was not drawn sharply but rather, in a way, arbitrarily.

In the research literature on IWBs applied in various school subjects, there are numerous arguments that support views on the positive impact of IWB technology on the didactic process. They are presented in chronological order to emphasize the shifts in the research focus from the introduction of IWBs into schools and educational institutions, usually associated with new opportunities to enhancing presentation and motivation and to the realization of IWBs' potential and the emerging need to change pedagogical approaches. However, studies also provide criticism of IWB technology and the challenges that educators face while introducing it into school environments. Thus, section 5 covers the pedagogical and technical challenges of IWBs, along with criticisms of the use of IWB technology in educational contexts.

The last section comprises the research on the use of IWB technology and its affordances in the language classroom, both in the context of teaching English as a second language and/or as a foreign language, which has increased significantly in the last couple of years. The discussion on IWBs in the language learning/teaching context starts from analyzing the pros and cons of the IWB technology

in English Language Teaching (ELT) and shifts its focus to the development of teaching practice and the efficacy of IWBs in the light of various SLA approaches to language learning and teaching.

2. The development of research on IWB technology

For the purposes of this article, IWB technology will be viewed in accordance with the definition employed by Cutrim Schmid and van Hazebrouck (2010). They define an IWB as a combination of a computer, a projector, and a screen, together with its connection to resources in the form of online and offline materials and Internet applications. Their definition of IWB technology as a *digital hub* also encompasses cooperating mobile devices, thus reaching outside of the classroom walls.

Interactive Whiteboard (IWB) technology was introduced into the school environment in the late 1990s/early 2000s and, since then, has become the subject of numerous research projects (e.g., Cuthell, 2005; Levy, 2002; Jewitt et al., 2007; Northcote et al., 2010; Turel & Johnson, 2012; Whyte, 2015) concerning its potential in education. The research on the applications of IWBs seems to have undergone at least two major phases of development (Cutrim Schmid, 2016; Hockey, 2013). The early period consisted of mainly small-scale research and focused on the positive influence of IWBs on students' motivation and interest and teachers' effectiveness in the use of IWBs. The earliest literature on IWB technology in education encompassed predominantly examples of good practice, descriptions of teachers' experience, perceived IWB benefits, and the results of small-scale projects. There was scarcely any academic empirical research conducted (Glover & Coleman, 2005; Higgins et al., 2007; Northcote et al., 2010; Smith et al., 2005; Walker, 2003).

The next period that commenced, approximately 2002-2007, was marked by large-scale studies (BECTA, 2004; Moss et al., 2007), university-based research, and a broader range of studies covering various school subjects. Thus, research concentrated on interactions in the IWB-based classroom, teaching praxis, and the issue of teaching effectiveness (Hockey, 2013; Northcote et al., 2010). Then, in the following years, research focus shifted to the development of enhanced interactivity and the need for a pedagogical change to a more student-centered, interactive, and collaborative approach (Northcote et al., 2010, p. 494). Therefore, research findings isolated the significant factors, such as the importance of professional training in both general Information and Communication Technology (ICT) competences and subject-specific ICT skills for teachers. The significance of the conditions that must be fulfilled to successfully introduce IWBs into the educational setting were thoroughly examined (Hockey, 2013). Additionally, studies on the added educational value of IWB technology (e.g., Beauchamp &

Parkinson, 2005; Harrison, 2013; Mercer et al., 2010), its potential to transform existing pedagogy towards supporting more socio-cognitive interaction (e.g., Northcote et al., 2010), its interactivity (e.g., Beauchamp & Kennewell, 2010), and the general impact of the use of IWB technology in all subjects (Ball, 2003; Whyte, 2013) were conducted.

In the selected literature review that follows, the main research themes are outlined. Covered first (Section 3) are the IWB potential advantages connected with teaching in general education, and second (Section 4), the IWB potential advantages connected with learning in school settings. Next (Section 5), pedagogical and technical challenges of IWB technology are analyzed, which is followed by a discussion of the specific IWBs affordances that make the technology highly useful in foreign language classrooms (Section 6). Further on, in section 6, IWB-based language classroom is presented from different SLA perspectives.

3. The potential benefits of the IWB technology in teaching

The following subsections cover the literature concerning the use of IWBs in teaching general school subjects in varied educational environments. First, the advantages of IWBs discussed here are the flexibility and versatility of IWB technology, which seem to be the main arguments for the deployment of IWBs in schools. Next, the research on expected IWBs' potential for pedagogy transformation is described, which seems to require an inevitable change in existing pedagogical approaches and formulas for teacher professional development. Subsequently, research concerning increased teaching time and pace of lessons achieved during IWB-based lessons is reviewed. Moreover, increased access to off- and online resources while using an IWB as a *digital hub*, the use of multimedia, and IWB modality are outlined. Furthermore, research on the IWB affordances of saving, sharing, and reusing didactic materials, which make the technology so useful from the teachers' point of view, is reported. Later, the issue of IWB interactivity is raised; however, as the theoretical models and research are so abundant, and due to the limitation of the review, it is done quite superficially. The next area discussed is the interrelation between IWB technology and professional development and, consequently, the need to reform it in such a way as to allow the educators to fulfill the technological and pedagogical potential of IWBs. Finally, in this section, research on the role of IWBs in assessment, feedback, and educational attainment is detailed.

3.1. IWB flexibility and versatility

The research literature shows that IWB technology, with its affordances, demonstrates exceptional flexibility and versatility and, as such, can be used during

lessons of majority of school subjects (Smith, 1999; Moss et al. 2007; Northcote et al., 2010; Torff & Tirotta, 2010). The use of IWB technology allows the introduction of ICT and technological skills into the context of multiple subjects (Beauchamp, 2004; Bennett & Lockyer, 2008; Cuthell, 2005; Levy, 2002; Smith, 1999, 2001; Smith et al., 2005; Somekh et al., 2007).

The technology can be applied in order to cater for the individual needs of students (Ball, 2003; Glover & Miller, 2001; Smith et al., 2005) because the resources, supported by an IWB, can be adapted to the needs of higher and lower ability learners (Levy, 2002). Moreover, the technology is suitable for students of different ages (from the very young to higher education students), and it is applicable for pupils of different learning styles (Cuthell, 2005). The application of touch-sensitive screens gives better access to an IWB for both young children and disabled students (Goodison, 2002, p. 26). IWBs, with their flexibility, confer numerous benefits for multisensory learners, especially those that are visual and kinaesthetic, as well as weaker students who benefit from IWB visual and interactive capabilities (Judge, 2013). The use of IWBs enriches the visual aspect of classes, and with dynamic images, numbers, diagrams, and graphs that can be changed and modified quickly, and has a strong motivational appeal (Ball, 2003; Mildenhall et al., 2008). Besides, IWBs are perceived as useful both in a regular school context as well as in distance education (Smith et al., 2005).

3.2. IWB potential for pedagogy transformation

The potential to transform the existing pedagogy into one that supports more socio-cognitive interaction has been discussed in the research literature on IWB technology (e.g., Northcote et al., 2010). The authors observe that attention should be paid to the complex interrelations between pedagogy and technology (Moss et al., 2007). The literature generally sees the relationship between pedagogy and technology as a process in which technology first supports, then extends, and finally transforms pedagogy, while teachers gradually discover and learn how to harness its affordances. Moss et al. (2007) emphasize that IWB technology itself does not transform currently used pedagogy. The transformation process requires time and gradual development of technological knowledge and skills and, as a result, a confidence in IWB use. The use of technology was justified by the content of curricula, and its value in accommodating the teacher's didactic aims and the learners' needs was confirmed by Moss et al. (2007). It has been pointed out that an important element in increasing the effectiveness of IWB-mediated teaching is the appropriateness of the pedagogy, not the use of the technology per se. The study findings generally confirm the assumption (Glover et al., 2007) that teachers become more open to changes in

their pedagogical methods after gaining more competence in the use of IWBs. In the early stages of teacher development in the use of IWB technology, an IWB is a tool to implement existing pedagogy, which limits IWB use to the role of a multimedia projector and is seen as simply a new method of presentation supported (or not) by the most basic IWB software. With time, as teachers develop confidence, they usually discover new applications, learn how to annotate presentations (e.g., PowerPoint), and move towards more interactive pedagogy (Beauchamp & Parkinson, 2005).

Moreover, the potential for pedagogy transformation embraces the IWBs' capacity to support scaffolding learning (Beauchamp & Parkinson, 2005). To achieve this, the teacher's role should undergo some modifications, such as changing from a dominant position to a co-learning one and accepting a new role as a facilitator or supporter, as well as developing ICT skills. Beauchamp and Parkinson (2005), in their reflective article on the add-on educational value of IWB technology, state that the advantages of IWBs are generally based on the possibility to use unique software tools, focus attention, contribute to scaffolding learning, introduce changes in pedagogy, and the ability to illustrate, explain, and solve problems. Furthermore, Warwick et al. (2010) used IWB affordances and embraced the opportunities it presented for collaborative learning in a science lesson, structuring scaffolding activities and stimulating interactivity. Warwick et al. (2010) conclude that the combination of technology, the learning task, and teacher support are the basis for the successful design and playing out of an attractive learning experience. Additionally, they claim that the teacher manipulating the parameters for pupil group interaction may initiate a dialogic discourse for pupil group work at an IWB. The authors connect the teachers' intentions for the use of particular IWB functions with the scaffolding classifications, referring to the ways the teacher constructs the engaging tasks to support learners in their cognitive and meta-cognitive activities. Moreover, the IWB-based activities may support development of higher order thinking skills (Harrison, 2013), development of conceptual understanding (Mildenhall et al., 2008; Somekh et al., 2007), and collaborative, dialogic activities (Warwick et al., 2010). Many authors see the educational potential of IWBs in integrating ICT into whole-class teaching to create more opportunities to interact and engage students in the classroom discussion or in classwide activities (Ball, 2003; Beauchamp & Parkinson, 2005; Judge, 2010; Mildenhall et al., 2008; Slay et al., 2008; Smith, 1999, 2001; Somekh et al., 2007). According to Levy (2002, p. 9), "the IWB can facilitate cohesive and participative whole-class learning," being a tool that supports students' cooperation and their engagement in active participation in the lesson.

Additionally, class control can be transferred from the teacher to the IWB making the teacher-learner interactions more student-centered and the class

management easier and more effective (Ball, 2003). The newest technological developments, such as mobile technology, open the possibility to manage the class from the level of the mobile phone. In some research, however, IWB technology mainly supported already functioning methods and lesson patterns and was predominantly used during whole-class teaching to improve the presentation of material to students, which poses the threat of the use of IWBs to reinforce teacher-centered, lecture-based *modus operandi* (Bennett & Lockyer, 2008; Mercer et al., 2010).

3.3. IWB interactivity

The authors and educators agree that the very IWB affordances for interactivity, communication, and collaboration are what make the boards appealing for use in teaching and learning contexts (Ball, 2003; Jewitt et al., 2007). Nevertheless, the issue of IWB interactivity seems to be highly intricate and is widely discussed in the literature. Different categories of IWB interactivity have been distinguished (Cuthell, 2005; Jewitt et al., 2007; Judge, 2013; Mercer, 2010; Mildenhall et al., 2008; Moss et al., 2007; Northcote et al., 2010; Smith et al., 2005) based on the relation with teacher as IWB users and the level of interactivity of IWB use in the classroom (Beauchamp, 2004; Beauchamp & Kennewell, 2010; Whyte, 2014). To avoid oversimplification, the issue of IWB interactivity would require a separate article in order to give a full explanation of its complexity.

3.4. IWB technology and professional development

Mastering IWB software can present both challenges and opportunities for educators but, at the same time, it may become an incentive for further professional development (Beauchamp & Parkinson, 2005). IWBs in the classroom create stronger motivation for learning and professional development for both students and teachers (Glover & Miller, 2001; Kennewell, 2001; Levy, 2002). The authors present multiple professional development models illustrating the stages that teachers go through as they engage with IWB technology.

Hooper and Rieber (1995, as quoted in BECTA, 2004 and in Northcote et al., 2010), recognize five non-hierarchical levels, while Glover and Miller (2001) observe three kinds of technology users. Further, Burden (2002) applies Gibson's model (1999) of the development of technology use in schools as a means of predicting the potential development of the use of interactive whiteboards. Moreover, Beauchamp (2004) constructs a generic progressive framework and developmental model for schools introducing IWBs. The framework includes phases of teacher development which, to be successful, require the adoption of an

interactive teaching style and the gradual development of specific ICT skills. A possible progression of IWB skills is described by Beauchamp and Parkinson (2005).

The research by Cutrim Schmid and Schimmack (2010), conducted on a model of IWB training for language teachers that incorporates a "bottom up" approach to teacher professional development in CALL and a pedagogical framework based on the socio-cognitive view of communicative teaching, identifies the main competences necessary for successful implementation of IWB technology in the language classroom. The competences include (Cutrim Schmid, 2010, p. 211):

1. The ability to design IWB materials which support opportunities for learner interaction with the whiteboard and with the learning content.
2. The skills to manage IWB-based activities in such a way that all learners can be actively involved in the learning process.
3. The capability to integrate numerous digital resources taking into account lesson pace, cognitive load, and active processing of material by learners.
4. The abilities to use both peripheral hardware and software and to find and evaluate ready-made materials for IWBs.

Moreover, the structure of effective teacher training should be based not only on a sound theoretical basis and a clear pedagogical framework but should also concentrate on teachers' immediate pedagogical needs with a contextualized example of technology use. The teachers involved should have the opportunity to gradually develop knowledge and experience and their training ought to be embedded in their actual work.

3.5. Increased teaching time and pace of lessons

The opportunity created by the IWB software and recognized by many authors is the increased teaching time (Glover & Miller, 2001; Walker, 2003) and pace of lessons (Moss et al., 2007; Northcote et al., 2010; Smith et al., 2005). The important changes that are enabled by IWB features are not only the change in the pace of lessons itself but also smooth transitions between different parts of the lesson and increased attention given by teachers to their class while using IWB technology (Beauchamp & Parkinson, 2005, p. 100). Although, at the beginning, the preparation for the IWB-based lessons requires more effort and/or a changed attitude on the side of the teacher, it results in improved lesson structure and pre-prepared activities (Ball, 2003; Glover & Miller, 2001; Judge, 2010). Using IWB resources prepared beforehand reduces time spent in writing and drawing on a traditional blackboard. The use of an IWB, especially in the first part of lessons, gives more time for interaction and task-related activities when the students work on their own (Levy, 2002).

3.6. Increased access to off- and online resources

In this paper the notion of IWB technology is understood in accordance with the definition coined by Cutrim Schmid and van Hazebrouck (2010), who perceive an IWB not only as a combination of a computer, projector, and a screen, but as a *digital hub.* Thus, IWBs are an interactive educational tool with its own software connected to worldwide resources and collaborating with mobile technology. Hence, an increased range of available educational materials and off- and online learning resources is available. The materials can be used more dynamically, for planned and unplanned activities during lessons (Beauchamp & Parkinson, 2005; Bennett & Lockyer, 2008; Glover & Miller, 2001; Kennewell, 2001; Levy, 2002; Mercer et al., 2010; Northcote et al., 2010; Smith et al., 2005).

3.7. Multimedia and modality in IWBs

The multimodality of an IWB itself, as well as the more competent and immediate access to multimedia and the possibility to deliver more powerful presentations, are pointed out by numerous authors (Glover & Miller, 2001; Smith et al., 2005). Functionalities often mentioned in the research of IWBs include:

1) an increased use of multimedia and multisensory resources (Moss et al., 2007; Smith et al., 2005);
2) the opportunities to use such distinctive teaching strategies as
   - capturing (copying and pasting from other software);
   - emphasizing (ticker tape function, large text, spotlight);
   - storing (saving flipcharts);
   - annotating and modifying (adding writing to texts and images, matching and rearranging elements, cloze exercises);
   - linking (to other flipcharts, computer files and programs, the Internet) (Beauchamp & Parkinson, 2005, p. 98).

3.8. IWB affordances: Saving, sharing, and reusing materials

The IWB affordances allow teachers and students to save, modify, record, print, or send whatever appears on an interactive whiteboard. Additionally, shared and reused materials may reduce workload for teachers, sparing time previously spent on writing on the board, photocopying, etc. (Glover & Miller, 2001; Smith, 2001). The possibility to save, print, and share lesson notes is perceived as a great but rarely utilized potential (Glover & Miller, 2001). The same function may be used for revision, review, and reinforcement, which is beneficial for both

learners present as well as absent during a lesson (Beauchamp & Parkinson, 2005; Bennett & Lockyer, 2008; Northcote et al., 2010). Moreover, didactic materials for IWBs can be produced collaboratively and then shared and modified (Cuthell, 2005), which is an option that in the long run can save time spent in preparing the lessons and allow reflection on lessons and materials from a wider perspective (Smith et al., 2005).

3.9. Assessment, feedback, and learning attainment

IWB technology connected to Internet polling applications and/or voting systems can be used to provide immediate assessment of learning outcomes. Using the voting system, a teacher narrows the gap between assessment and feedback by providing immediate feedback to the learners. In this way, the teacher can give students the opportunity to discuss their reactions during the lessons, which may result in an increased learner engagement and make the learning process more interactive (Cuthell, 2005). Additionally, Judge (2013) reports on his research findings, drawing on Somekh et al. (2007), that although investigating learning attainment was not the aim of his study, it seems that if the teachers had permanent access to IWBs for at least two years, increased learning attainment could be achieved. However, to actually achieve the changes in pedagogy that result in a more significant improvement of learning and school attainment, rather than the results obtained with non-digital tools, the teachers' pedagogical content knowledge must develop to include ICT knowledge and skills (Mishra & Koehler, 2006).

4. The potential benefits of IWB technology in learning

The potential impact of the introduction of IWB technology on the process of learning is closely interlaced with its influence on teaching. Nevertheless, there are numerous features that make the presence of an IWB in a classroom advantageous from learners' points of view (Cuthell, 2005; Harlow et al., 2010). The following subsections outline the visual impact of IWBs (BECTA, 2004; Harlow et al., 2010; Slay et al., 2008), the opportunities given by IWB technology to create student-centered classrooms with more collaborative and autonomous learner interactions (Wall et al., 2005; Nothcote et al., 2010), the improved motivation, attention, and behaviour of learners (Beauchamp & Parkinson, 2005; Harlow et al., 2010; Kennewell & Beauchamp, 2007), materials made using and shared via IWBs for learners (Cuthell, 2005; Harlow et al., 2010), the potential for ICT diffusion, and the development of ICT skills in an IWB-based classroom (Cuthell, 2005; Levy, 2002; Smith et al., 2005).

4.1. Visual appeal of the IWB technology

Since the very first research on the use of IWBs in the classroom (BECTA, 2004), the benefits of enhanced visibility have been frequently pointed out. IWB visibility is widely understood, not only in terms of the sheer visibility of text and images, but also the affordances that allow changing text color, annotating on the screen, hiding and revealing text, and zooming in and out of text, pictures, images, tables, diagrams, and graphs that can be moved and modified *in situ,* thus providing support for students in visualizing complicated concepts and demonstrating skills (Ball, 2003; BECTA, 2004; Northcote et al., 2010; Slay et al., 2008; Somekh et al., 2007). The analysis of research findings shows that interactivity and multimodality of IWBs in the form of the variety of visual, auditory, and text-based functions (Mercer et al., 2010) can be successfully applied as incentives and motivation for critical thinking, analyzing, and reasoning.

The visual impact of the information and resources displayed can increase the efficiency and effectiveness of teaching and learning (Levy, 2002). The multimedia and multisensory capacity of IWB technology also seems to promote and enhance the process of learning; for example, visual or multi-sensory presentations are claimed to help memorize material. Smith et al. (2005) point out that the literature relates to the reinforcement of learning with "the unique physical and tactile nature of boards" (p. 76). With their flexibility, IWBs exhibit numerous advantages for multisensory learners, intellectual capacity students, and different learning styles (Harlow et al., 2010; Judge, 2013; Levy, 2002; Smith et al., 2005). The students appreciate the visual character of IWBs, pointing out that with their support the information can be presented in various modes, which is perceived as a method of strengthening concentration and attention (Wall et al., 2005). They can discern details, which makes it easier for them to understand things and helps them to remember and recall information. Additionally, teachers' use of multimedia, such as small video clips to encourage whole-class discussion, seem to be very beneficial for the learning process (Levy, 2002; Moss et al., 2007). With the help of colors, movement, and sequential development, the IWBs "provide the focus for visualization" of concepts (Cuthell, 2005). Visual information is easier to share and helpful in "drawing the class together" (Levy, 2002), which may consequently support learners in changing the way they participate in classroom interactions, as asking and answering questions may be addressed immediately on the board.

Moreover, another important function performed by the IWB software is the possibility of presenting students' work on IWBs, then saving and sharing them with different digital media (Kennewell & Beauchamp, 2007; Levy, 2002; Smith et al., 2005). The possibility to use peripherals with an IWB, e.g., a visualizer or digital microscope, also enhances the IWB's visual capacity (Harlow et al., 2010; Moss et al., 2007).

4.2. Student-centered, collaborative and autonomous learning environment

With the introduction of IWBs and the underlying pedagogical transformation, the classroom environment can potentially transform into a space owned and self-directed by the students themselves. Numerous authors (Ball, 2003; Harlow et al., 2010; Moss et al., 2007; Martin, 2009; Northcote et al., 2010) discuss opportunities for collaborative and autonomous learner interaction in the classroom and the students' involvement. The claims that the informed the use of IWBs increases the level of interaction, communication, collaboration, and engagement in learning and teaching situations have been supported. Studies show that participating teachers used IWBs as tools supporting student-centered pedagogy and, if IWBs were used for presentation purposes, the activities that followed were more student-centered and interactive (Northcote et al., 2010; Warwick et al., 2010). The process of an IWB transformation from simply a presentation medium or screen to an interactive didactic aid seems to progress through developmental phases. The potential of IWB technology in the interaction stage is characterized by student-centeredness, collaboration, and advanced use of interactive technologies (embedded objects, multimedia, peripherals), which makes learning authentic and engaging, fulfilling learners' needs (Saville et al., 2014, p. 209). The research shows that teacher-student interaction as well as the three-way interaction of teacher, pupil, and learning material can be facilitated by IWB affordances (Levy, 2002; Northcote et al., 2010; Smith et al., 2005). Management of a classroom which allows students to interact with an IWB that is consequently used in a student driven way increases their contribution and involvement in learning (Northcote et al., 2010; Wall et al., 2005).

4.3. Improved motivation, attention, and behavior of learners

As was briefly mentioned in section 3.2, researchers observe improved motivation and affect of learners, increased lesson variety, more creativity in lessons on the part of the students, evident enjoyment among learners, and a stronger motivation for learning and professional development, among both students and teachers (Beauchamp & Parkinson, 2005; Glover & Miller, 2001; Harlow et al., 2010; Kennewell, 2001; Levy, 2002; Northcote et al., 2010; Smith et al., 2005; Wall et al., 2005).

It has been agreed that the boost in student motivation resulting from IWB use was the main benefit provided by the more captivating and visible presentations which show information in various formats evoking students' interest (Mercer et al., 2010; Torff & Tirotta, 2010). Slay et al. (2008) identified the value of using up-to-date technology, which captivates learners' attention for a longer span of time, increases student motivation, and employs interactive affordances that support

active participation in classes. Moreover, IWB-based lessons seem to be more contained and structured, as they are preceded by careful planning which is imposed by the technology on teachers (Saville et al., 2014). Interestingly, the findings revealed that the level of motivation in the group that participated in IWB-mediated lessons in comparison to a control group (students taught without IWBs) was higher, and the teachers who were strong proponents of IWBs produced larger motivational effects in their students (Judge, 2013).

4.4. Materials made for and shared with learners via IWBs

According to Cuthell (2005), not only the teachers but the learners as well can benefit from publications and materials produced collaboratively by educators and published on local networks or made available digitally. When students have comfortable access to resources and materials, they are able to relate new information to previous lessons, catch up on the elements they missed, and, generally, take responsibility for their own learning.

Moreover, an IWB can be an effective stimulus for teacher-student interaction as a means of encouraging students to respond to questions. As their answers are put on IWB flipcharts and discussed, they see that they are contributing to generating learning resources (Levy, 2002). In IWB-based classes all students can contribute to the learning process in the way that is most convenient for them, as the IWB technology caters for different abilities and learning styles, which is also appreciated by learners (Smith et al., 2005). Students' annotations and drawings on the IWB can be saved for reuse, and the IWB functions as a "digital hub," allowing the teacher to exploit different resources and the learners to see and interact with media (Harlow et al., 2010).

4.5. ICT diffusion and development of ICT skills

IWB technology invites ICT into the classroom, allows for the diffusion of technology, and requires the development of ICT skills from both teachers and students (Cuthell, 2005; Levy, 2002; Smith et al., 2005). In the context of pre-service teacher preparation for the integration of IWBs, research confirms that tutor modelling and hands-on examination of IWB affordances and ICT tools seemed to be the best approach to promoting technological and pedagogical skills. Teachers who achieved success in IWB use recognized the positive reaction of their students and intensified its use, which consequently led to higher self-efficacy (Peled et al., 2015). Smith et al. (2005) perceive IWB technology as supporting the development of ICT skills in learners, which is caused by the fact that students observe a teacher operating the system, facilitated by the size and

clarity of images and movements on the IWB. Therefore, the presence of an IWB can become a positive incentive for teacher-student cooperation and co-learning (Beauchamp & Parkinson, 2005).

5. Pedagogical and technical challenges of IWB technology

Relevant IWB literature also considers the challenges that are connected with the introduction and implementation of IWB technology into the educational environment. The problematic factors can be generally divided into two categories: pedagogical (Glover & Miller, 2001; Beauchamp, 2004; Smith et al., 2005; Somyurek et al., 2009; Such et al., 2012; Wall et al., 2005) and technical (Levy, 2002; Moss et al., 2007; Slay et al., 2008; Somekh et al., 2007; Somyurek et al., 2009). The pedagogical issues are connected with the crucial issues mentioned in sections 3.7 and 3.8, which include the professional development of teachers and educators in the technology field, the improvement of educators' understanding of IWB use in the classroom, and the implementation of interactivity into IWB-based education.

The introduction of IWBs as an element of the school system/culture appears to be more evolutionary than revolutionary (Bennett & Lockyer, 2008) and requires a lot of effort from teachers in the form of acquiring ICT and IWB skills. These skills constitute the foundations of the modification and transformation of the existing pedagogy to one that offers the space for technology and facilitated interaction among all participants throughout the process (teachers, learners, materials, technology, etc.). Thus, insufficient and/or inadequate technical and methodological teacher training, especially in the teacher specific subject area, constitute serious and insurmountable obstacles (Beauchamp, 2004; Glover & Miller, 2001; Smith et al., 2005; Somyurek et al., 2009; Such et al., 2012; Wall et al., 2005). Moreover, insufficient preparation and understanding might lead to the reinforcement of whole-class teaching or transmission style of teaching (BECTA, 2004; Mercer, 2010; Moss et al., 2007; Northcote et al., 2010) and to the IWB only being used as a presentation tool to support existing pedagogy (Moss et al., 2007; Northcote et al., 2010). Additionally, there is a lack of ready-made teaching and learning materials designed for IWBs and the preparation of IWB materials and teaching aids can be quite time consuming (Somekh et al., 2007; Somyurek et al., 2009; Such et al., 2012).

Although many publishing houses have published coursebooks with IWB options, they are usually in the form of books meant to be projected and manipulated on the screen. One of the main requirements to develop digital/IWB skills is regular access to IWB-equipped classrooms, which seems to be limited (Glover & Miller, 2001; Levy, 2002). The issue that is frequently revealed in the studies and has a serious discouraging and frustrating effect, both on teachers and learners,

is the problem of technical difficulties, network and equipment failures, and the resulting need for immediate technical support (Levy, 2002; Moss et al., 2007; Slay et al., 2008; Somekh et al., 2007; Somyurek et al., 2009). Besides, Levy (2002) proposes that the issue requires contingency planning from the teachers.

The literature generally agrees that the improved visibility of IWB technology is one of its most important assets, so problems in visibility and clarity of images and text in certain conditions such as strong sunlight become quite a critical problem (Glover & Miller, 2001; Levy, 2002; Smith et al., 2005). Finally, one considerable deterring factor, crucial in many educational situations, is that of the high price of the equipment (Jones & Vincent, 2006; Northcote et al., 2010; Slay et al., 2008; Smith et al., 2005; Wall et al., 2005).

6. IWBs in foreign language classroom

The research on IWB technology in the educational environment and its findings is applicable in foreign language classrooms. Accordingly, the literature on the IWB affordances as they are seen in the language classroom has grown recently. There are some specific issues characteristic for language teaching and learning that are examined in ETL context. The following sections outline research on the IWB functions that the authors find the most pertinent to language learning. Additionally, it discusses the potential of IWB technology to transform the existing language teaching pedagogy into one that combines modern technology and is based on current SLA theory and research.

6.1. IWB affordances in the language classroom

Research connected with the use of IWB technology to teach and learn languages confirms the practicality of IWBs' affordances (Cutrim Schmid, 2009; Gray, 2010). The findings show that the benefits of IWB application include greater engagement, deeper interest, and enhanced motivation (Bettsworth, 2010). Research reports that the use of IWB technology combines resources suitable for various learning styles and emphasizes direct access to off- and online multimedia resources with smooth transitions among them, making the lessons more attractive and helping students to concentrate on them. Furthermore, studies indicate that IWBs may facilitate learning by making the content more understandable for the students by presenting materials in various forms, taken from diversified online resources (Cutrim Schmid, 2008, 2010; Whyte, 2013).

The list of commonly discussed activities in the literature is broadened in the context of language learning, by the use of IWB affordances enabling the use of color, handwriting, highlighting, dragging and dropping, hiding and revealing, and

handwriting recognition. Moreover, tools such as web browsing, snapshot creation, interactive exercise design, and remote devices can be utilized along with IWBs in language learning. The possibilities of learner response or voting systems engage pupils even further and improve interactivity in lessons (Cutrim Schmid, 2006, 2007, 2008, 2009, p. 492).

Some affordances of IWBs especially lend themselves to language learning. Visually, the functions which allow the use of different colors, font sizes, and animation can support language learners in noticing particular characteristics of language. IWBs also allow the integration of multimedia (images, sound, and text) in order to create multi-sensory presentations which can show language concepts such as grapheme/phoneme relations. Materials can be recorded, stored, and recalled in later lessons, while providing immediate access to various resources during the lesson, which allows students to review older material as they learn new information. Not only can students review and revise their own work, but, through an IWB, they are also given the chance to present what they have done to other learners (in the form of audio, video, and text files). Such presentations allow them to evaluate themselves and others and use this feedback to work on their accuracy and constitute important incentives in motivating and engaging students during language lessons.

Additionally, IWB technology can be used to bring assorted learning experiences to the classroom, including the integration of interactive off- and online games, as well as real life situations, with the access to authentic language material and the capability to interact with native language speakers via video-conferencing options (Gray, 2010, p. 73).

The affordances listed above are perceived as those which increase the teacher's control over the learning process, those which connect the classroom with the world, utilizing an abundance of authentic language materials, and, finally, those which allow the use of more flexible approaches to learning. Apart from the general characteristics of the IWB technology in foreign language classrooms, a more detailed description of its functions appears in Bettsworth's 2010 study, aimed at surveying the effectiveness of IWB use in understanding and remembering some grammar elements in an Modern Foreign Language (MFL) class of a secondary school. The key IWB features used in this class were the use of color to mark the text (to indicate discussed tenses), the movement of text around the board (re-ordering words in the sentence, categorizing words or phrases, demonstrating specific features of word order), the function enabling the creation of timelines, the ability to change, highlight, or undo answers on the board before or even during their presentation, and the possibility to discuss among the whole class or even collectively grade student presentations. The study supports the claim that IWB-based lessons involve more whole-class teaching, and IWBs generate more discussion on the language itself.

Whyte (2013) argues that with the support of IWBs applied as a *digital hub* or *dashboard*, learning and cognitive development may be orchestrated using IWB functions to display, monitor, and control certain aspects of language learning. IWB functions allow monitoring of events that happen in different contexts (in and out of the classroom, face to face and online), mediating activities that involve authentic, modified, and learner language, accommodating input from teachers and learners, and lastly enabling individual, group, or whole class work. Moreover, the use of some of these online applications and platforms to present the students' work allows the student access to their own work and the work of others from outside the school and the ability to comment on them if posted, for example, on a class blog (Cutrim Shmid, 2009).

6.2. IWB-based language classroom from different SLA perspectives

The main aim of the research in this field comprises the design, implementation, and evaluation of IWB-assisted foreign/second language lessons that are informed by current theory and research. Thus, conducted research concentrates on the potential of IWB technology in the language classroom, which serves as a platform for integrating different types of ICT from the perspective of cognitive learning theory (Cutrim Schmid, 2008), a gateway to numerous Internet resources and online applications (Cutrim Schmid, 2009, p. 495), a platform for collaboration (Cutrim Schmid, 2009, p. 496), and a presentation platform for 'student-generated Web 2.0 content' (Cutrim Schmid, 2009, p. 498).

The findings indicate that a suitable methodology to be applied in the IWB-based language classroom must include not only the multimedia elements influencing the process of learning and teaching, but also materials of pedagogical quality, as well as relevant didactic methods for the multimedia environment. The success of using the discussed technologies depends on factors such as teachers' methodological choices and pedagogical beliefs, teachers' knowledge of the material, teachers and pupils' levels of media literacy, teachers' experience with the technology, teachers' access to technology training, and the stage of technological implementation (Cutrim Schmid, 2008, p. 1567).

The introduction of new technologies can open the space for the implementation of a constructivist-based learning paradigm, and the increased access to technology can lead teachers to change their practices and, further, their continuous professional development (Cutrim Schmid, 2009, p. 491). Two factors seem to play the main part here, namely the role of teachers in the realization of technological potential and the role of the IWB applications which "create new opportunities for transformative learning" (Cutrim Schmid, 2009, p. 492).

The need for awareness and insight into the sociocultural environment and the specific subject context when introducing a new technology into education is emphasized by Gray (2010) in her article focusing on IWB technology in MFL classrooms. Cutrim Schmid and van Hazebrouck (2010) aim to illustrate "the identification and implementation of effective ways of integrating IWB in the English curriculum and the critical evaluation of the use of this technology in the content of several lessons, and the extent to which it is compatible with current theories of language acquisition" (p. 12). The conclusions drawn from the study are that the teacher's competences should include the digital skills to operate numerous ICT tools, the ability to refrain from the use of technology, and the capability to employ various interaction configurations to provide language practice.

Research by Cutrim Schmid and Schimmack (2010) suggests at least three key competences that teachers need to develop to be able to use technology to promote a learner-centered pedagogy. Firstly, they need to learn how to design IWB materials which support opportunities for learner interaction, between the IWB and the lesson content. Secondly, they need to develop strategies for managing IWB-based activities in a way that ensures all learners have opportunities to become actively involved in the learning process. Finally, they need to be able to coherently integrate various multimedia resources in their IWB-based lessons, taking into consideration pace, cognitive load, and learners' active processing of these materials.

7. Conclusion

The main aim of this review was to highlight selected relevant publications concerning IWB technology, first in general education and then in the context of ELT/language learning. The discussion of the utility of IWBs in schools and research on IWB affordances mainly concerns the tasks and challenges faced by teachers of foreign/second languages in modern educational institutions. On the other hand, it also points out the untapped potential of IWB technology that might support the major shift towards modern teaching paradigms. The major conclusions of the research are the interdependence of technology and pedagogy and the need for technologically informed professional development of in-service and future teachers.

References

Ball, B. (2003). Teaching and learning mathematics with an interactive whiteboard. *Micromath, 19*(1), 4-6.

Beauchamp, G. (2004). Teacher use of the interactive whiteboard (IWB) in primary schools – towards an effective transition framework. *Technology, Pedagogy and Education, 13*(3), 329-349.

Beauchamp, G., & Parkinson, J. (2005). Beyond the 'wow' factor: Developing interactivity with the interactive whiteboard. *School Science Review, 86*(316), 97-103.

Beauchamp, G., & Kennewell, S. (2008), The influence of ICT on the interactivity of teaching. *Education and Information Technologies, 13*(4), 305-315.

Beauchamp, G., & Kennewell, S. (2010). Interactivity in the classroom and its impact on learning. *Computers & Education, 54*, 759-766.

BECTA. (2004). *Getting the most from your interactive white board: A Guide for Primary Schools*. Coventry: British Educational Communications and Technology Agency (BECTA). http://www.dit.ie/Ittc/media/ditIttc/documents/gettingthemost.pdf

Bennett, S., & Lockyer, L. (2008). A study of teachers' integration of interactive whiteboards into four Australian primary school classrooms. *Learning, Media and Technology, 33*(4), 289-300.

Bettsworth, B. (2010). Using interactive whiteboards to teach grammar in the MFL Classroom: A learner's Perspective. In M. Thomas & E. Cutrim Schmid (Eds.), *Interactive whiteboards for education: Theory, research and practice* (pp. 216-224). Information Science Reference Hershey.

Cuthell, J. P. (2005). *The impact of interactive whiteboards on teaching, learning and attainment*. In J. Price, D. Willis, N. Davis, & J. Willis (Eds.), *Proceedings of SITE 2005* (pp. 1353-1355). Association for the Advancement of Computing in Education.

Cutrim Schmid, E. (2006). Investigating the use of interactive whiteboard technology in the language classroom through the lens of a critical theory of technology. *Computer Assisted Language Learning, 1*9(1), 47-62.

Cutrim Schmid, E. (2007). Enhancing performance knowledge and self-esteem in classroom language learning: The potential of the ACTIVote system component of interactive whiteboard technology. *System, 35*, 119-133.

Cutrim Schmid, E. (2008). Potential pedagogical benefits and drawbacks of multimedia use in the English language classroom equipped with interactive whiteboard technology. *Computers and Education, 51*(4), pp. 1553-1568.

Cutrim Schmid, E. (2009). The pedagogical potential of interactive whiteboards 2.0. In M. Thomas (Ed.), *Handbook of research on web 2.0 and second language learning*. IGI Global.

Cutrim Schmid, E. (2010). Developing competencies for using the interactive whiteboard to implement communicative language teaching in the English as a Foreign Language classroom. *Technology, Pedagogy and Education, 19(2),* 159-172.

Cutrim Schmid, E., & Schimmack, E. (2010). First steps towards a model of interactive whiteboard training for language teachers. In M. Thomas & E. Cutrim Schmid (Eds.), *Interactive whiteboards: Theory, research and practice*. IGI Global.

Cutrim Schmid, E., & van Hazebrouck, S. (2010). Using the interactive whiteboard as a "digital hub". http://www.oldenbourg-klick.de/uebersicht?search_api_views_fulltext=cutrim&f=clear

Cutrim Schmid, E., & van Hazebrouck, S. (2012). Material development and task design for the interactive whiteboard in the foreign language classroom. In K. Biebighäuser, M. Zibelius, & T. Schmidt (Eds.), *Aufgaben 2.0 – Konzepte, Materialien und Methoden für das Fremdsprachen Lehren und -lernen mit digitalen Medien*. Narr.

Davies, G. (2002). ICT and modern foreign languages: Learning opportunities and training needs. *International Journal of English Studies*, *2*(1), 1-18. https://revistas.um.es/ijes/article/view/48371

Glover, D., & Coleman, M. (2005). School climate, culture and ethos: Interchangeable or distinctive concepts? *Journal of In-Service Education*, 31(2), 251-272.

Glover, D., & Miller, D. (2001). Running with technology: The pedagogic impact of the large-scale introduction of interactive whiteboard in one secondary school. *Journal of Information Technology for Teacher Education, 10*(3), 257-276. http://www.virtualclassrooms.info/iwb/articles/IWBpedagogicimpact.pdf

Glover, D., Miller, D., Averis, D., & Door, V. (2007). The evolution of an effective pedagogy for teachers using the interactive whiteboard in mathematics and modern languages. An empirical analysis from the secondary sector. *Learning, Media and Technology, 32*(1), 5-20.

Gray, C., (2010). Meeting teachers' real needs: new tools in the secondary modern foreign language classroom. In M. Thomas & E. Cutrim Schmid (Eds.), *Interactive whiteboards for education: Theory, research and practice*. Information Science Reference Hershey.

Harrison, N. (2013). Using the interactive whiteboard to scaffold a metalanguage: Teaching higher order thinking skills in preservice teacher education. *Australasian Journal of Educational Technology, 29*(1), 54-65.

Harlow, A., Cowie, B., & Heazlewood, M. (2010). Keeping in touch with learning: The use of an interactive whiteboard in the junior school. *Technology Pedagogy and Education 19*(2), 237-243.

Higgins, S., Beauchamp, G., & Miller, D. (2007). Reviewing the literature on interactive whiteboards. *Learning, Media and Technology 32*(3), 213-225. https://doi.org/10.1080/17439880701511040

Hooper, S., & Rieber, L. (1995). Teaching with technology. In A. Ornstein (Ed.), *Teaching: Theory into practice* (pp. 154-170). Allyn and Bacon.

Jewitt, C., Moss, G., & Cardini, A. (2007). Pace, interactivity and multimodality in teachers' design of texts for interactive whiteboards in the secondary school classroom. *Learning, Media and Technology, 32*(3), 303-317.

Jones, A., & Vincent, J. (2006). *Introducing interactive whiteboards into school practice: One school's model of teachers mentoring colleagues*. [Paper presentation]. AARE Annual Conference, Adelaide. http://www.aare.edu.au/data/publications/2006/jon06333.pdf

Judge, M. (2013). Documenting teachers and students experiences with interactive whiteboards in Ireland: Key findings from an Irish pilot project. In M. Thomas & E. Cutrim Schmid (Eds.), *Interactive whiteboards for education: Theory, research and practice* (pp. 250-263). Information Science Reference Hershey.

Kennewell, S. (2001). Interactive whiteboards – yet another solution looking for a problem to solve? *Information Technology in Teacher Education, 39*, 3-6.

Kennewell, S., & Beauchamp, G., (2007). The features of interactive whiteboards and their influence on learning. *Learning, Media and Technology, 32*(3), 227-241.

Levy, P. (2002). *Interactive whiteboards in learning and teaching in two Sheffield schools: A developmental study*. Department of Information Studies, University of Sheffield.

Mercer, N. (2010) Interactive whiteboards and classroom interactions. *Better: Evidence-based Education, 3*(1), 8-9.

Mercer, N., Hennessy, S., & Warwick, P. (2010). Using interactive whiteboards to orchestrate classroom dialogue. *Technology, Pedagogy and Education, 19*(2), 195-209.

Mildenhall, P., Swan, P., Northcote, M., & Marshall, L. (2008). Virtual manipulatives on the interactive whiteboard: A preliminary investigation. *Australian Primary Mathematics Classroom, 13*(1), 9-14.

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6). https://pdfs.semanticscholar.org/977d/8f707ca1882e093c4ab9cb7ff0515cd944f5.pdf

Moss, G., Jewitt, C., Levaaic, R., Armstrong, V., Cardini, A., & Castle, F. (2007). *The interactive whiteboards, pedagogy and pupils performance evaluation: An evaluation of the Schools Whiteboard Expansion (SWE) project: London challenge. DfES Research Report RR 816*. DfES

Northcote, M., Mildenhall, P., Marshall, L., & Swan, P. (2010). Interactive whiteboards: Interactive or just whiteboards? *Australasian Journal of Educational Technology, 26*(4), 494-510.

Peled, Y., Medvin, M., & Domanski L. (2015). Integrating IWB use in western Pennsylvania K-12 schools districts: The professional development connection. *The Journal of Interactive Learning Research, 26*, 289-305.

Saville, M., Beswick, K., & Callingham, R. (2014). The use of interactive whiteboards in education. Opportunities and challenges. In N. Fitzallen, R. Reaburn, & Fan, S. (Eds.), *The future of educational research. Perspectives from beginning researchers* (pp. 203-218). SensePublishers.

Slay, H., Sieborger, I., & Hodgkinson-Williams, C. (2008). Interactive whiteboards: Real beauty or just "lipstick"? *Computers and Education, 51*(3), 1321-1341.

Smith, A. (1999). *Interactive whiteboard evaluation*. https://mirandanet.ac.uk/blog/2015/01/13/interactive-whiteboard-evaluation

Smith, H. (2001). *Smartboard evaluation: Final report*. Kent NGfL. http://www.kented.org.uk/ngfl/whiteboards/report.html

Smith, H. J., Higgins, S., Wall, K., & Miller, J. (2005). Interactive whiteboards: Boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning, 21*(2), 91-101.

Somekh, B., Haldane, M., Jones, K., Lewin, C., Steadman, S., Scrimshaw, P., Sing, S., Bird, K., Cummings, J., & Downing, B. (2007). *Evaluation of the primary schools whiteboard expansion project. Report to the Department for Education and Skills*. MMU.

Somyurek, S., Atasoy, B., & Ozdemir, S. (2009). Board's IQ: What makes a board smart? *Computers and Education, 53*(2), 368-374.

Such, Ch., Miller, M., Everett, C., Davis, G., Howlett, P., & Martin, E. (2012). Exploring the impact of training on the use of interactive whiteboards (IWB) and how lecturers integrate their use in higher education classrooms. *Networks, 15*, 17-21.

Torff, B., & Tirotta, R. (2010). Interactive whiteboards produce small gains in elementary students' self-reported motivation in mathematics. *Computers & Education, 54*(2), 379-383.

Wall, K., Higgins, S., & Smith, H. (2005). The visual helps me understand the complicated things: Pupil views of teaching and learning with interactive whiteboards. *British Journal of Educational Technology, 36*(5), 851-67.

Walker, R. (2003). Interactive whiteboards in the MFL classroom. *Tell & Call, 3*(3), 14-16.

Warwick, P., Mercer, N., Kreshner, R., & Staarman, J. K. (2010). In the mind and in the technology: The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers & Education, 55*(1), 350-362.

Whyte, S. (2013). *Orchestrating learning in the language classroom: The IWB as digital dashboard*. http://babylonia.ch/fileadmin/user_upload/documents/2013_3/Whyte.pdf

Whyte, S. (2014). Theory and practice in second language teaching with interactive technologies. In E. E. Cutrim Schmid & E. Whyte (Eds.), *Teaching languages with technology: Communicative approaches to interactive whiteboard use. A resource book for teacher development*. Bloomsbury.

Whyte, S. (2015). *Implementing and researching technological innovation in language teaching. The case of interactive whiteboards for EFL in French schools*. Palgrave Macmillan UK.