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INTERACTIVE WHITEBOARDS FOR TEACHING AND LEARNING SCIENCE: ASCERTAINED RESEARCH

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Abstract

The purpose of this paper is to analyze of latest research focused on the investigation of interactive whiteboards used in teaching and learning Science. In the theoretical framework the main objectives are: a) the identification of specific research regarding the integration of interactive whiteboards in teaching and learning Science and b) the elaboration of an innovative model based on defining the criteria of classification of the research directions in this field. In order to achieve the aim of the study, an ascertained research is employed. The empirical basis of the study consists of content analysis of current research at international level in connection with the components of the innovative model defined in the theoretical part. The findings reveal the current context of educational research focused on integrating interactive whiteboards in teaching and learning Science, as a starting point for the implementation of an innovative project in Romanian higher education.

Key words*:* educational research, higher education, learning, teaching, whiteboard

Introduction

Using computer-based technology such as data-logging and simulations is important for modeling subjects such as Science. The presence of computer-based technology (Shih, Huang, Hsu, & Chen, 2012)changes the way subjects such as Science are being taught. There is growing evidence that information and communication technologies have a positive effect on student's attainment in science (Van Veen, 2011). Especially with abstract concept lessons like Science, the usage of educational technologies and materials is very crucial (Akçay, Feyzioğlu, & Tüysüz, 2003; Serin, Bulut, & Saygili, 2009). Educational technologies and materials, which offer additional opportunities for learning and putting forward what you know, provides different

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learning environments and maintains permanent and interactive learning. Teachers will incorporate in Science lesson a specific set of knowledge, abilities and values in three different domains of technology, pedagogy and science.

The interactive whiteboard (IWB) is part of information and communication technologies(ICT) enhanced learning and teaching Science and is able to combine a lot of beneficial features of ICT in one medium. Isman et al. (2012) consider that interactive whiteboard is “a large touch-sensitive and interactive display that connects to a computer and projector”. According to Higgins, Beauchamp, and Miller (S. Higgins, Beauchamp, & Miller, 2007), “the use of IWB may be the most significant change in the classroom learning environment in the past decade”. Kennewell and Beauchamp (Kennewell & Beauchamp, 2007) describe lessons with IWB, which give a more visual and dynamic look, resulting in the fact that students spent longer looking at the board rather than the teacher. They describe teachers also showing projected graphs and tables which are particularly common in science work. Many students encountered numerous difficulties in learning Science and it was the subject which students felt most anxious and afraid. The use of IWB in the classroom can make a difference for students who have trouble with thinking abstractly in abstract subjects, because it makes the teaching/ learning process more concrete, when using the features of the IWB (Bui, 2009).

Within the context of using the interactive whiteboard in the teaching and learning of Science, many surveys emphasize the effectiveness of using this technology toolto improve students’ capacities and teachers’ professional development. Due to the increasing body of research that is emerging from the implementation of IWBs in learning and teaching science, analysis has been necessary to summarize and identify general trends. Smith et al. (H. Smith, Higgins, Wall, & Miller, 2005) consider there are two main categories of research which have emerged from theirs study of the reference literature: “the IWB as a tool to enhance teaching and as a tool to support learning”. The authors identified in the literature the potential benefits of IWBs for teaching: flexibility and versatility, multimedia/multimodal presentation, efficiency, supporting planning and the development of resources, modeling information and communication technologies skills, interactivity and lesson participation. Also, they find the unique features of IWBs relate to the promotion of pupils’ learning and falls into the following categories: motivation and affect and multimedia and multi-sensory presentation.

There are identified two categories of specific approaches regarding the integrations of interactive whiteboards in teaching and learning Science according to the general reference literature.

a. The IWB as a tool to support learning Science

The studies are based on establishing the correlation between using interactive whiteboards and different factors of learning Science:

- learning outcomes, achievement, performance(Akbaş & Pektaş, 2011; BECTA, 2002; Dhindsa & Emran, 2006; Huang, Liu, Yan, & Chen, 2009; Hwang, Chen, & Hsu, 2006; Lazăr, Mâţă, Ifrim, Mateian, & Lazăr, 2013; Murcia, 2010; Somekh, Haldane, & Jones, 2007; Swan, Kratcoski, Schenker, & Hooft, 2010; Thompson & Flecknoe, 2003; Van Lankvelt, 2009; Van Veen, 2011; Veselinovska, 2014; Yang & Wang, 2012);

- gender differences in learning Science(Dhindsa & Emran, 2011; Emron & Dhindsa, 2010);

- motivation, engagement and interaction, participation and attitudes of students in Science learning process(Huang, et al., 2009; Kershner, Mercer, Warwick, & Staarman, 2010; Mercer, Warwick, Kershner, & Staarman, 2010; Schut, 2007; Singh & Mohamed, 2012; Stoica, Jipa, Miron, Ferener-Vari, & Toma, 2014; Torff & Tirotta, 2010; Van Lankvelt, 2009; Vetter, 2009).

b. The IWB as a tool to enhance teaching Science

The studies are focused on identifying the correlation between using interactive whiteboards and different factors of teaching Science:

- the pedagogical implications and outcomes of the use of interactive whiteboards(Campbell & Martin, 2010; Gadbois & Haverstock, 2009; Gillen, Littleton, Twiner, Staarman, & Mercer, 2008; Glover, Miller, & Averis, 2003; S. Higgins, E., 2010; Miller, Averis, Door, & Glover, 2005; Veselinovska, 2014);

- the perceptions of pre-service and in-service teachers of interactive whiteboard training and its usefulness in teaching science(Emron & Dhindsa, 2010; Jang & Tsai, 2012; Wong, Goh, & Osman, 2013);

- the impact on teacher-pupil interaction (F. Smith, Hardman, & Higgins, 2006; Warwick, Mercer, Kershner, & Kleine Staarman, 2010);

- the use of interactive whiteboards to develop the Technological Pedagogical Content and Knowledge of teachers(Jang, 2010; Jang & Tsai, 2012);

- the motivational effects of using interactive whiteboards in classrooms (Miller, Glover, & Averis, 2004);

- the use of interactive pedagogies in the IWB classroom to support whole class substantive discourse about science (Murcia & Sheffield, 2010).

In the Romanian educational system, there are neither theoretical models nor researches, or programs aimed at developing educational solutions for integrating interactive whiteboards in teaching and learning Science in higher education. There are few studies based on the presentation of good practices on integrating interactive whiteboards in teaching science. Stoica et al. (2011) present the way in which teachers can promote an interactive learning and stimulate students' creative potential, by using the interactive whiteboard and the cognitive load theory in teaching Physics.

The two categories of identified specific approaches will provide the reference framework for the content analysis of ascertained research.

Method

The objective of the present study consists of the analysis of researches focused on the use of interactive whiteboards in teaching and learning Science.

There are verified two general investigation hypotheses.

Hypothesis 1: The researches focused on the use of interactive whiteboards in teaching and learning Science reflect the specific themes, in relation with the disciplines, in a different manner.

Hypothesis 2: The researches focused on the use of interactive whiteboards in teaching and learning Science reflect the specific themes, in relation with the educational level, in a different manner.

In the content analysis of the research focused on the use of interactive whiteboards in teaching and learning Science were integrated the two categories, corresponding to specific approaches identified in the theoretical part: a. The IWB as a tool to support learning Science, with the following components: cognitive development, engagement, behavior, engagement level, attitudes, creative potential, cultural aspects); and b. The IWB as a tool to enhance teaching Science, with the following components: knowledge, pedagogical support, engagement, socio-cultural aspects, technological aspects.

To identify categories, corresponding to specific approaches regarding the integrations of interactive whiteboards in teaching and learning Science the content analysis was used to distinguish the specific themes which correspond to every indicator. The content analysis aims at the quantitative analysis of the documents, intending to highlight themes, trends, attitudes, values and patterns using as a mechanism the conversion of a symbolic qualitative material into a quantitative one. The study values the variants of the thematic analysis(Bardin, 1977): categorical analysis, which is based on grouping themes into categories and calculating frequencies.The content analysis method provides a set of advantages: it enables quantitative and qualitative operations; enables statistical analysis of coded form of the text; it is a means to analyze interactions; it provides a deep knowledge of complex patterns of thought and language use(Agabrian, 2006). The value of an analysis depends on the quality of prior conceptualization (hypothesis, variables), of the analysis scheme or categories, of the concordance between the investigated reality and the ideal conceptual elements. The content analysis is a research method appropriate to explore studies in educational sciences, as it can be seen in some studies (Göktaş et al., 2012; Saban, 2009). The thematic content analysis is applied for the research data analysis(Vaismoradi, Turunen, & Bondas, 2013)to establish general themes and specific categories related to the research which aims at IWB use in teaching and learning science.

The content analysis was performed between July and September 2014. There were selected and analyzed the specific research focused on the use of interactive whiteboards in teaching and learning Science achieved in the last ten years (2001-2014).

The dependent variable is represented by the categories of indicators, while the independent variables are: subjects (Mathematics, Biology, Chemistry, Physics, Science) and educational level (primary school, secondary school, high schools, higher education).It must be specified that in primary education therepresentative subjects are Mathematics and Science, compared to secondary education, high school and higher education, where the distinct subjects areMathematics, Physics, Chemistry and Science.

Findings

Hypothesis 1 is confirmed, because the researches focused on the use of interactive whiteboards in teaching and learning Science reflect the specific themes, in relation with the disciplines, in a different manner. To verify this hypothesis, the frequency of the specifications differentiated on disciplines was analyzed for each category of specific themes.

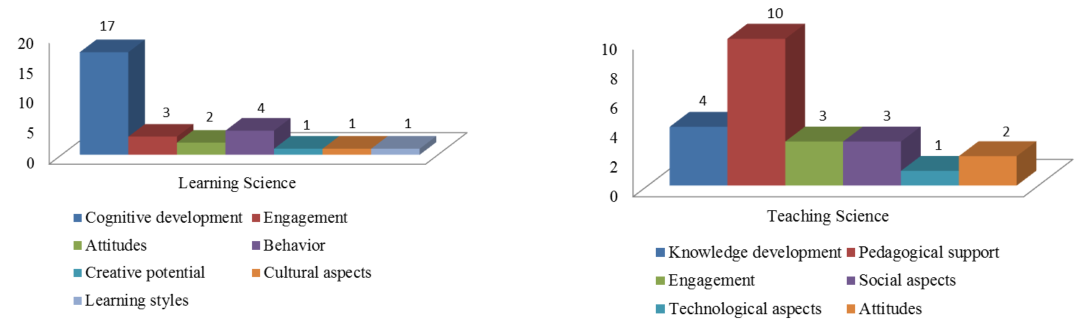
There are differences regarding the categories of factors that facilitate the integration of IWB of learning and teaching Science, as it can be seen from Table 1and Figure 1:

- From the point of view of *learning Sciences*, the frequencies illustrate that most research are conducted more to highlight the positive effect in using the IWB to facilitate the cognitive development (17) rather than to stimulate the creative potential, the learning styles (1), to identify the importance of cultural aspects (1), or to identify the attitudes of students (2).

- From the perspective of *teaching Sciences*, the frequencies highlight that most research are achieved more to investigate the role of IWB as pedagogical support (10) rather than as an instrument of cognitive development (4) or the influence of integration of IWB upon engagement, social relations (3) or teachers' attitudes, perceptions, representations upon new technologies (2).

Table 1. Categories and specific themes at the level of research focused on the use of IWB in teaching and learning Science, differentiated on disciplines (M - Mathematics, B - Biology, C - Chemistry, P - Physics, S - Science)

Categories and specific themes		**The frequency of the specifications**					**Total**
		M	**B**	**C**	**P**	**S**	
a. The IWB as a tool to support learning Science	a.1. cognitive development (achievement, performance)	8	2	1	1	5	*17*
	a.2. engagement (motivation, interest, concentration, self-esteem)	2	-	-	-	1	*3*
	a.3. attitudes, perceptions, representations	-	1	-	1	-	*2*
	a.4. behavior (interaction, participation, collaborative communication)	-	-	-	-	4	*4*
	a.5. creative potential	-	-	-	1	-	*1*
	a.6. cultural aspects (gender differences)	-	-	1	-	-	*1*
	a.7. learning styles	-	-	-	-	1	*1*
	Total	*10*	*3*	*2*	*3*	*11*	*29*
b. The IWB as a tool to enhance teaching Science	b.1. knowledge development	2	-	-	-	2	*4*
	b.2. pedagogical support (planning and preparation, assessment, teaching style)	2	1	1	-	6	*10*
	b.3. engagement (motivation, classroom focus, interactivity)	1	-	1	-	1	*3*
	b.4. social aspects (social interaction, working together)	1	-	1	-	1	*3*
	b.5. technological aspects (ICT skills)	-	-	1	-	-	*1*
	b.6. attitudes, perceptions, representations	-	-	-	-	2	*2*
	Total	*6*	*1*	*4*	*0*	*12*	*23*



a b

Figure 1. Graphic representation of frequency of the specific themes, differentiated on the two categories: learning (a) and teaching (b)

There are significant differences related to the integration of IWB in learning and teaching Science disciplines, as it can be seen from Table 1and Figure 2:

- From the point of view of *learning Sciences*, the frequencies illustrate that most research are conducted to highlight the positive effect in using the IWB at Science (11) and Mathematics (10), comparatively to Biology (3), Physics (3) and Chemistry (2).
- From the perspective of *teaching Sciences*, the frequencies highlight that most research are achieved to investigate the way of IWB integration at Science (12), comparatively to Mathematic (6), Chemistry (4), Biology (1) and Physics (0).

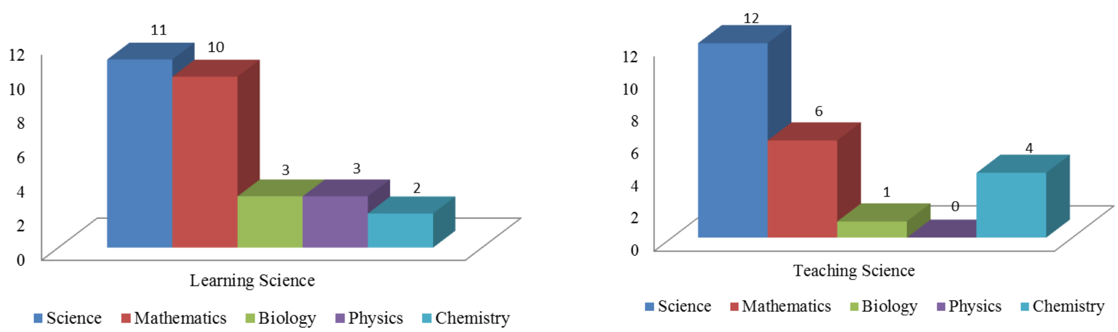


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Figure 2. Graphic representation of frequency of the categories of themes, differentiated on disciplines: learning (a) and teaching (b)

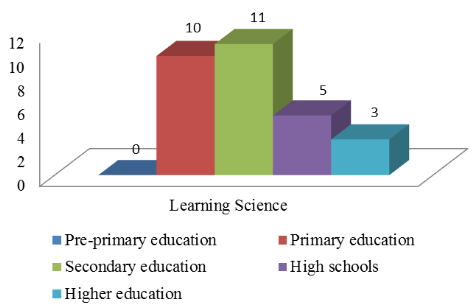
Hypothesis 2 is confirmed, because the researches focused on the use of interactive whiteboards in teaching and learning Science reflect the specific themes, in relation with the educational level, in a different manner. To verify this hypothesis, the frequency of the specifications differentiated on the educational level was analyzed for each category of specific themes.

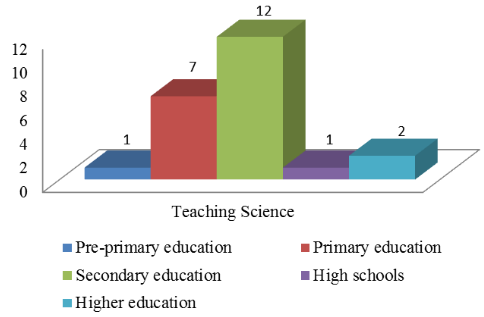
There are significant differences related to the integration of IWB in learning and teaching Science in function with the educational level, as it can be seen from Table 2and Figure 3:

- From the point of view of *learning Sciences*, the frequencies illustrate that most research are conducted to highlight the positive effect in using the IWB in secondary education (11) and primary education (10), comparatively to high school (5) and higher education (3).
- From the perspective of *teaching Sciences*, the frequencies highlights that most research are achieved to investigate the way of IWB integration in secondary education (12) and primary education (7), comparatively to higher education (2), high school (1) and pre-primary education (1).

Table 2. Categories and specific themes at the level of research focused on the use of IWB in teaching and learning Science, differentiated on educational system levels (PP – pre-primary education; PE – primary education, SE - secondary education, HS - high school, HE – higher education)

Categories and specificthemes		**The frequency of the specifications**					**Total**
		PP	**PE**	**SE**	**HS**	**HE**	
a. The IWB as a tool to support learning Science	a.1. cognitive development (achievement, performance)	-	5	6	3	3	*17*
	a.2. engagement (motivation, interest, concentration, self-esteem)	-	2	1			*3*
	a.3. attitudes, perceptions, representations	-		1	1		*2*
	a.4. behavior (interaction, participation, collaborative communication)	-	3	1			*4*
	a.5. creative potential	-		1			*1*
	a.6. cultural aspects (gender differences)	-			1		*1*
	a.7. learning styles	-		1			*1*
	Total	*0*	*10*	*11*	*5*	*3*	*29*
b. The IWB as a tool to enhance teaching Science	b.1. knowledge development		2	2			*4*
	b.2. pedagogical support (planning and preparation, assessment, teaching style)	1	2	4	1	2	*10*
	b.3. engagement (motivation, classroom focus, interactivity)		1	2			*3*
	b.4. social aspects (social interaction, working together)		1	2			*3*
	b.5. technological aspects (ICT skills)			1			*1*
	b.6. attitudes, perceptions, representations		1	1			*2*
	Total	*1*	*7*	*12*	*1*	*2*	*23*





a b

Figure 3. Graphic representation of frequency of the categories of themes, differentiated on educational level: learning (a) and teaching (b)

Discussions and conclusions

The conclusions can be formulated at both theoretical level and in terms of current ascertained research in the field of using interactive whiteboards for teaching and learning Science. At the theoretical level, there are identified two categories of specific approaches in connection with reference literature: the IWB as a tool to support learning Science and the IWB as a tool to enhance teaching Science.

After analyzing the results of the statistical data, the following specific conclusions can be stated.

a) The most research regarding the effects of using interactive whiteboards upon students learning is conducted in Mathematics and science subjects and lesson the subjects Physics and Chemistry. From the perspective of the impact of new technologies in the teaching process, the results are very similar, in the sense that most studies are achieved in science and Mathematics disciplines, the fewest in Chemistry discipline and none in Physics. Hayes (2010)noticed that research is significantly lacking on IWB use in continued employee professional development and training.

b) Referring to the educational level, research has been predominantly conducted to find effects of this medium on students in secondary and primary schools. To this date the researcher was not able to find research on the effects of using IWB in science teaching in higher education.

Further research is needed to understand how this new technology affects student learning and teaching Science at the level of all categories of factors. The results obtained will constitute the point of starting to investigate the positive effects of IWB integration for learning and teaching Science in Romanian higher education.

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