Using an Interactive Whiteboard to Increase the Effectiveness of Teaching at Secondary Schools

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Abstract

Modern electronic devices and teaching aids are constantly innovating education. Education has recently undergone many changes. Currently, the latest trend in the modernisation of teaching is represented by an interactive whiteboard. When used correctly, it represents a modern didactic tool that contributes to innovation and the efficiency of teaching a specific subject. This contribution aims to provide up-to-date information on using interactive whiteboards in secondary school teaching. In the paper, the authors describe the results of the conducted research. They focus on using the interactive whiteboard from the student's point of view and the teacher's. Using several research methods, the authors investigated the frequency of use of the interactive whiteboard and the learners' opinions towards its use. They also investigated the possibilities of streamlining the teaching process.

Keywords: Interactive whiteboard, Technical subject, Secondary school, Effectiveness of teaching

1 Introduction

Modernisation of the teaching process is essential when students and teachers are expected to have more technical skills. Education has recently undergone many changes, primarily new educational programs and the modernisation of the teaching process. This is also related to introducing newer and more advanced electronic devices into the teaching process to make it more efficient. Over the past decade, interactive whiteboards (IWBs) have become widely used teaching technology. One of the main reasons for the large-scale adoption of IWB in

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schools is that it can improve the teaching of the entire class by enhancing the visual impact and interactivity of the lesson (Gregorcic et al., 2018). Transforming secondary education is a long-term project. The use of IWBs can contribute to this goal under the right circumstances. A discussion of pedagogy should precede and include a discussion of technology use, methodology and effectiveness. A successful learning process is most effective when it helps individual teachers review their current pedagogy and see how IWB can support, extend, or transform it. Discussing the relative strengths and weaknesses of different ways of using technology for a particular purpose should be a part of the ongoing process of integrating and using new technology, in our case IWBs.

Technologies played a specific role during the COVID pandemic when they somehow consolidated their position in teaching theory and, more so, in educational practice. Among the technologies discussed were also IWBs. Many authors in their publications highlighted or criticised the role of the IWB during the COVID pandemic (Hargaš et al., 2022; Szőköl, 2022; Pondelíková, 2022, Bautista-Vallejo, et al., 2020, Wenham, 2022). Our experience showed that IWBs proved their validity and motivated teachers and learners to use them effectively in pedagogical practice, which was also reflected in face-to-face teaching.

2 IWB in the educational process

Different authors give the characteristics of IWB. IWB systems provide a multimodality environment wherein images, texts, and insertions from other software programmes (e.g., mathematical software) can be combined and manipulated directly on the screen by teachers and students (De Vita et al., 2018). Analysing the professional literature, we found dozens of definitions of IWB, which are similar in content. We put together the following definition through the penetration: An IWB is a digital whiteboard that gives you all the capabilities of your computer on a whiteboard. Plus, you can use your finger to write on the screen in digital ink. Then you can save, print, or distribute your notes at the touch of a button; you can access multimedia files, collaborate on activities by allowing two or more people to write on the screen simultaneously, and access the Internet and teleconference. Some authors (Dostál, 2009, 2011, Betcher & Lee, 2009) approach the IWB characteristic from a different perspective when they define it as a touch-sensitive surface through which mutual communication takes place between the user and the computer in order to ensure the maximum possible degree of visibility of the displayed content.

From a narrower point of view, IWB can be understood as an electronic device used in an educational environment as a material didactic tool intended for educational purposes. We can consider it as the basis of an interactive classroom, i.e., a system consisting of a computer, a data video projector and a blackboard while representing the first type of educational technology suitable for whole-class interaction.

In the broadest sense, an IWB consists of electronic devices and software for user interface, display, processing and editing. The basis is a computer to which a sizeable

interactive surface is connected – the blackboard itself, which allows the position of a pen or finger to be sensed and a data projector or other display device. The projector projects the image from the computer onto the board's surface, which also serves as a controller for the computer's cursor. The cursor is controlled by a special pen (stylus), a finger, or a marker with light-reflecting elements. The board is usually attached directly to the wall (like a classic school blackboard), or it can be placed on a mobile stand. A bare white wall can also be used when using an independent pen position sensor.

IWB has undergone technological development since its inception around 1990, when it was designed and manufactured for use in the office, primarily in small group meetings and roundtables. Although individual IWBs currently differ from one another depending on the manufacturer and the target environment, in principle, the IWB is a combination of individual components, as shown in Figure 1.

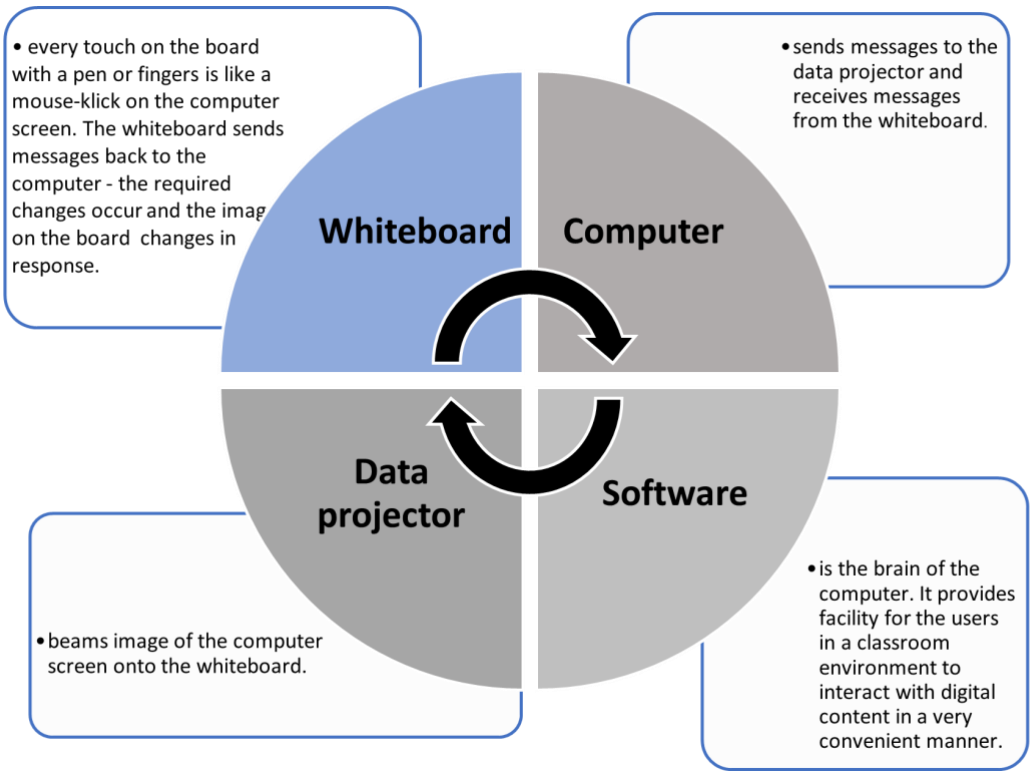

Fig. 1: Components of typical IWB, their interaction and functions (Source: authors)

2.1 Interactivity as the Main Feature

When working with IWB, interactivity and an interactive environment play an essential role. By interactivity, we generally mean a feature of teaching that enables mutual communication between the teacher and students, between students, between students and educational content, teaching aids and didactic techniques. In essence, it is about connecting all the components of the didactic process into one whole. As seen in Figure 2, you can imagine this communication as a combination of reading and writing, discussion, listening, individual or joint creation and reflection (Langer, 2016).

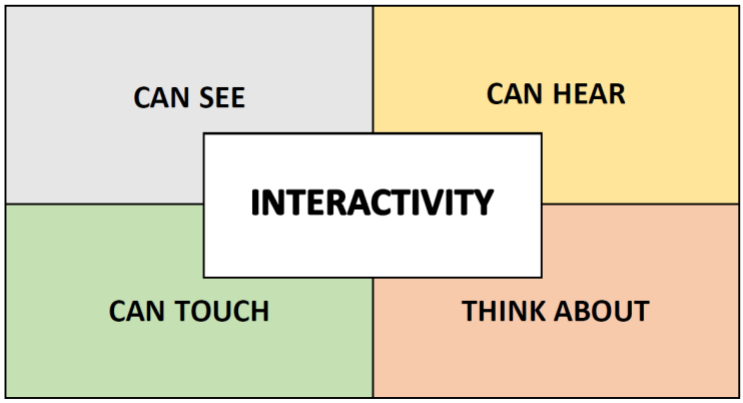

Fig. 2: Ideal interactivity (created by the authors according to Langer, 2016)

Our classroom observations showed that teachers conceptualised interactivity differently in their teaching practice. The interactive use of technology we observed can be categorised as follows:

- Technical interactions focused on interactions with the technical facilities of the board.
- Physical interactivity with a focus on “moving on” and manipulating elements on the board.
- Conceptual Interactivity – Emphasis on interacting, exploring, and building with curriculum concepts and ideas.

How IWB-related interactivity is understood and used in the classroom appears to underlie specific teacher practices and be shaped by teaching-learning theories more widespread in departments and schools. It also depends on:

- Subject and topic requirements;
- Student's perceptual abilities;
- Available time;
- Peripherals available.

Together, these elements help shape teachers' educational objectives, methodology and the way they use IWB. All these findings correlate closely with published knowledge and findings

of Moss et al. (2007). Many authors (Northcote et al., 2010; Wood & Ashfield 2008; Ahmad & Ali, 2019; Kühl & Wohninsland, 2022) deal with the interactivity in the teaching process stimulated by the multimodality of IWB and the subsequent creativity of learners as an output of activities mediated by working with IWB. Their works inspired our research, and we were pleased that the results of our research coincide in many findings with the already published findings of the authors we mentioned.

3 Materials and methods

3.1 Main aim and objectives of the research

The main goal of the research was to determine the impact of using IWB on teaching the professional subject of physics.
The partial objectives were:
O1: To find out if learners are more active when using IWB in class than those without using IWB.
O2: To find out whether the use of IWB has an impact on a better understanding of the new subject matter.
O3: To find out whether using IWB affects better memorisation of new material.
O4: To find out how teachers use IWB in teaching a professional subject.

3.2 Hypotheses of the research

The determination of the hypotheses resulted from the stated objectives of the research. As part of the research, the following hypotheses were established:
H1: Learners who use IWB in class are more active than those in traditional classes.
H2: Learners who use IWB in class understand the new subject matter better than those who do not use IWB.
H3: Learners who use IWB remember new material better in class than those who do not use IWB.
H4: Teachers who use IWB for teaching a professional subject consider their teaching more effective than teachers who do not use IWB.

3.3 Methodology of the Research

We adjusted the methodology to quantitative and qualitative methods considering the planned research activities. Based on the established research objectives and research hypotheses, we used the following research methods:

- method of analysis and synthesis of knowledge in the field of using IWBs in teaching,

- method of observation in physics lessons, using recording sheets and recording devices (camera, video camera),
- interview method with students and physics teachers,
- a questionnaire method to find out the opinions and attitudes of students towards the use of an IWB,
- mathematical-statistical methods for processing and evaluating research results.

We chose a set of several research methods with which we wanted to obtain the most accurate and objective information regarding the set goals and hypotheses of the research. Due to a better orientation, we considered the analysis and synthesis of knowledge necessary before starting the research. We drew information from printed sources (books and research articles) and electronic sources, where we searched for some already carried out research on the mentioned issue. We applied the observation method in the physics subject lessons in the first to third year of grammar school. For comparison, we completed peer observations in teaching physics with the use of IWB, as well as in traditional classes. We completed six peer observations, two lessons each in the first to third year. During the lessons, we watched the course of the lesson. We focused on the teacher's work in the lesson's motivational, expositional, fixation and diagnostic phases. We also monitored the students' work during class. We made short records of observations. For later analysis of the teaching, we created 5-7 photos and a 25-minute video recording from each lesson. We conducted the interview with the students in the school classroom between individual lessons. During it, the students provided us with additional information that we did not catch during the observation in class. We conducted interviews with the teachers before the start of the lesson. We were interested in the preparatory phase of the teachers, setting teaching goals and defining the curriculum.

We used the questionnaire to collect information from the students. The questionnaire was compiled in such a way that it was not too lengthy and, at the same time, had sufficient informative value. The students filled out the questionnaire within 10 minutes. It contained 19 items, of which 14 were closed items, two semi-closed items and three open items. Of the closed items, two were dichotomous (two choices), and the other were polytomous (multiple-choice). A set of closed items allowed students to choose an answer from the options offered. Semi-closed items allowed students to choose the offered answer or complete the answer. Students could add their answers to the open items. These answers offered us a wide range of information. In item no. 4, we investigated whether the more frequent use of IWB could increase teaching effectiveness. In items no. 6 and no. 7, we investigated whether IWB contributes to a better understanding and memorisation of new material. In items no. 8 and no. 9, we investigated students' satisfaction with the current use of IWB. In item no. 10, no. 11, we investigated how IWB affects cooperation between classmates, as well as between students and the teacher. In item no. 12, we were interested in how they use the IWB. In items no. 14, 15 and 16, we investigated how active students are when working with IWB. In item no. 17, we investigated students' motivation for working with IWB. In items no. 18 and 19, we were interested in the positives and negatives of using IWB, from the student's point of view.

We applied mathematical and statistical methods after collecting the necessary data for their evaluation.

3.4 Research Sample

We carried out the research at the Secondary Grammar School in Svidník, Komenského 16, Slovakia. This Grammar School is fully comprehensive. In the school year 2022/2023, it has six classes of the 4-year study, a total of 148 students. The educational process is ensured by 13 professionally and pedagogically qualified teachers (of which 10 are women) and three qualified external teaching staff (for teaching religious education).

The research sample consisted of two basic groups of respondents – students and physics teachers. The group of students consisted of a total of 110 respondents, of which 49 were boys (45%), and 61 were girls (55%). Of these, 39 first-year students, 38 second-year students and 33 third-year students (Table 1).

RESPONDENTS – LEARNERS	BOYS	GIRLS	TOTAL
1st year	17	22	39
2nd year	18	20	38
3rd year	15	18	33
TOTAL	**50**	**60**	**110**

Table 1: Respondents of the research – learners

4 Research Results

In this paper, we focused on interpreting partial research results in connection with objectives O1, O2, and O3 and the verification of hypotheses H1, H2, and H3.

Verification of hypothesis H1:
H1: Learners who use IWB in class are more active in class than those in the traditional class.
The established hypothesis was also based on questionnaire question no. 14:
Are you more active when using IWB in class than during traditional teaching?

The students answered the above question as follows: “Certainly yes” was answered by 18 students (17%), 40 students (36%) answered “Rather yes”, 26 students (23%) answered “Rather no”, 8 students (7%) answered “Definitely no”, and the option “I do not know” was chosen by 18 students (17%). A graphical representation of answers can be seen in Figure 3.

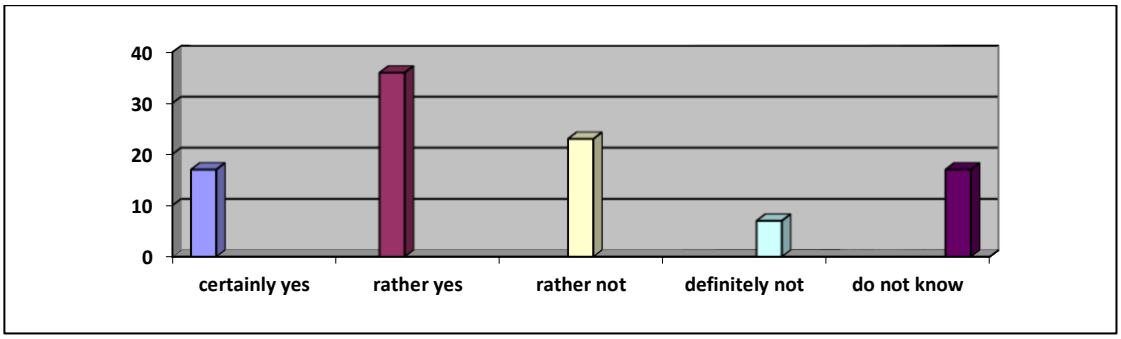

Fig. 3: Self-assessment of students' activity when using the IWB

The results of question no. 14 of the questionnaire show that 17% of students state in their self-evaluation that they are more active during lessons if IWB is used. In the interview, they later told us they could no longer imagine teaching only with a classic blackboard. As many as 36% of students answered “rather yes”. In the interview, they later told us that they are active primarily in the lesson with the IWB but also with the use of other electronic devices. 23% of students chose the “rather not” option. Seven per cent of students chose the option “definitely not”. Seventeen per cent of students could not comment on the question.

This result was also confirmed by the observation method in the class. During the lesson, we observed that a larger group of students was active throughout the lesson. Another smaller group of students developed an activity after the teacher's invitation or after assigning a specific task. Based on the questionnaire method, the method of observation and the interview, we found that the number of students who are more active in teaching the subject of physics with the use of IWB prevails. However, the difference is not opposed. Hypothesis H1 was confirmed in this case.

Verification of hypothesis H2:

H2: Learners who use IWB in class will understand the new subject matter better than those who do not use IWB.

The established hypothesis was based on questionnaire question no. 6:

Does IWB contribute to a better understanding of the new curriculum?

The students answered the question as follows: 36 students (33%) answered “definitely yes”, 49 students (45%) answered “rather yes”, 4 students (3%) “rather not”, 6 students (5%) “definitely not”, 15 students (14%) could not express themselves. The questionnaire results show that IWB contributes to a better understanding of the new subject matter among a larger group of students. There is a preponderance of students who better understand the new subject using IWB in class than when using a classic blackboard. During the interview, some students told us that it is primarily due to better visualisation of the new subject matter, better “engagement in the issue”, and the possibility of better cooperation between classmates and the teacher and between students. Hypothesis H2 was confirmed. It means

that IWB contributes to a better understanding of the new curriculum in the subject of physics, among students in the first to the third year of Secondary Grammar School.

Verification of hypothesis H3:

H3: Learners who use IWB in class will remember new material better than those who do not use IWB.

The established hypothesis was based on questionnaire question no. 7:

Does IWB contribute to a better memorisation of new subject matter?

The students answered this question as follows: 19 students (17%) answered “Definitely yes”, and most of the students questioned, up to 52, answered “Rather yes”, which represents (47%). Thirteen students (12%) answered “Rather not”, and 10 students (9%) answered “Definitely not”. Sixteen students (15%) could not comment on the question. In the interview, some students told us that they can remember the material better thanks to the interactive exercises they practice on the IWB. The teacher can use, for example, a quiz in the form of a question and answer, at the end of which he will receive immediate feedback from the students with a point evaluation. Some students said that such a quiz is too fast for them and that they need more time to memorize new issues. These results were also confirmed in the diagnostic phase of the lesson. Hypothesis no. 3 was confirmed, which means that IWB contributes to a better memorization of new subject matter.

The evaluation of both hypotheses H2 and H3 and the self-assessment of students' understanding and memorisation of the subject matter are shown in Figure 4.

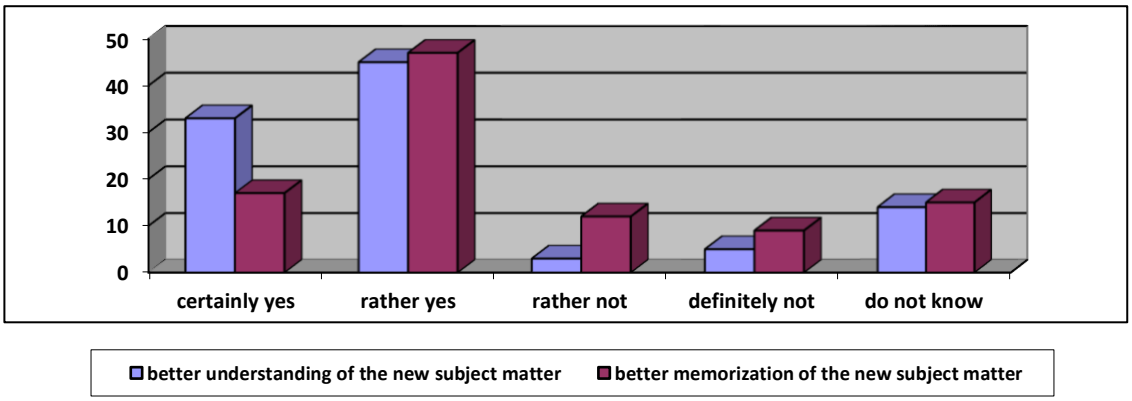

Fig. 3: Self-assessment of students' opinions and experience with the impact of IWB on better understanding and better memorization of new material

4.1 Summary and Recommendations

Based on our findings, we formulated the following recommendations for subject teachers who use IWB:

- when working with IWB, involve more individual students in the work than the whole group,
- allow students more time to work with IWB,
- reduce stress factors in students that arise during work with IWB,
- apply more interactive exercises in the lesson,
- to look for methods and forms of motivation for less active students when working with IWB.

Overall, the results showed that the students and teachers of the Secondary Grammar School in Svidník entertained a positive attitude towards using the IWB indicating that it was enjoyable and effective as an instructional tool and technological adjunct to classroom lessons.

5 Conclusion

Information and communication technologies and the IWB are fundamental and important landmarks in the innovation of the teaching process at all types of schools in Slovakia. Progress and developmentally unstoppable trends of digitisation have brought changes in the current era of education as well. The classic classroom and specialised classroom is transformed into a 21st-century classroom, in which the teaching process takes place with the help of new modern tools and teaching aids. In the continuity of the development of science, it pushes the boundaries of efficiency and the ability to acquire new knowledge, skills, and habits not only for students but also for teachers who organise and manage the teaching process.

As we mentioned in the introduction, the latest trend in the modernisation of teaching is represented by interactive technology presented by IWB. When used correctly, the IWB is a modern didactic tool that contributes to innovation and improving the teaching of professional subjects. Today we know that the trend of using IWB in secondary education is progressing. Schools are increasingly equipped with modern IWBs, which teachers and students must learn to work with. It is up to the teachers themselves how they will use the IWB in the lessons of their subject. Whether they will fully use its potential to make teaching more efficient or use IWBs only sporadically. Active student participation is also essential, as IWB is the first means of whole-class interaction. Without students' active participation, it is impossible to fully utilise the potential of IWB, which creates the assumption of less effective teaching of specialised subjects.

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