Journal of Subject Didactics, 2017

Vol. 2, No. 2, 97-108, DOI: 10.5281/zenodo.1239754

Original Article

Application of an Interactive Whiteboard in the Realization of Entomological Programme Contents

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Abstract

In this paper an analysis of the application of an interactive whiteboard (IWB) in the biology teaching was presented. The types of interactive whiteboards, their advantages and disadvantages, the contextual factors on which the application depends, the positive and negative effects in teaching and learning and pedagogical aspects and strategies for applying interactive whiteboard are described. Also, an example is given how the IWB was applied in the realization of entomological programme content. The role and importance of insects in nature have been shown. It is very important that students understand the role of insect (especially insect pollinators) and their importance in nature. With the help of an IWB, this biology programme content was presented in the form of the concept maps. This allowed students to understand the significance of different entomological concepts and relations among them. Also, an overview of the researches about the uses of an IWB in biology teaching in the realization of various biological programme content was given. It was shown that the IWB contributed to the improvement of processes of teaching and learning. It was concluded that IWB is determined as positive teaching tools, and researches show that they could have a positive impact on the motivation, perception, attention, behavior of students and their achievements in teaching biology. Application of IWB can be easily accomplished with little additional training (for teachers and students). In the future, training of teaching staff for the use of IWB in teaching biology is planned.

Keywords*: biology teaching; interactive whiteboard (IWB); interactivity; entomological programme contents.*

Introduction

An interactive whiteboard (IWB) is touch-sensitive board used with a combination of a computer and digital projector. It resembles a traditional whiteboard and is used similarly. The computer connected to the IWB can be controlled by touching the board directly or by using a special pen. This connection is enabled by application of specific software (Smith et al., 2005). It is an electronic device that allows interactive work with the computer directly from the table itself by clicking on the projected image with an interactive

pen or finger (Mercer et al., 2010). This system allows the board to become one large sensitive surface from which it is possible to operate the computer. The board is connected to a computer via a USB port or wirelessly with Bluetooth, Infrared, and Wi-Fi. It is possible to have a large number of texts, charts, diagrams, films or animations on a computer of the interactive board preserved for teaching. Sponge using to erase objects is simple, and every object (line, geometric body, more complex illustration) can be freely manipulated. Information is sent from the board to the computer for further storage, or in the form of a command that is projected in a fraction of a second on a board. The image is controlled by a computer and it serves as a curtain on which information is continually designed and as a generator of feedback into the computer system (Raonić, 2012).

It can be distinguished two types of IWBs from the point of view of the projection direction, those with the front projection and those with the rear projection. They can also be divided into static, mobile, and portable in relation to the way they are connected and set up. The connection of the board can be provided via USB cable or wireless (Brecka&Oleksakova, 2013).

From the point of view of methods and way of management of the whole system, they are divided into hard and soft boards. For hard IWBs, there should be one suitable surface (mostly a whiteboard). One sensor and one special pen (which works with the help of a battery) is required here too (next to computer, projector and design surface). These models are more mobile. In soft IWBs, the surface is sensitive to touch. No additional writing pen is needed and they are similar to the classical board. The same functions are possible with the help of a finger (touch) of the teacher, but there are several colored pens in addition to the board also. With the help of a large number of microcontroller sensors located below the surface of the board, these functions are enabled (Mernjik, 2013).

The beginning of the application of an IWB was in business life, but it quickly turned out that application was desirable in education. Since IWBs allow the teacher the freedom in teaching, because it is not bothered by the mouse and the keyboard of the computer, interactivity is fully realized. With the help of a special pencil for an IWB or by simple touch of a finger, it is possible to perform operations that are performed by the computer mouse (left and right click, double click, scroll, etc.), and the classic keyboard is replaced with the virtual keypad and handwriting recognition. In this way, the course of the teaching becomes fluid and natural, and students are able to see it easily because the teacher is beside the projected image at all times (Mernjik, 2013).

Together with the rapid development of technology, computer-supported technology, which includes IWB, is embedded in the education system of many countries. In developed and developing countries, governments and schools intensively invest in the technology of interactive whiteboard (Slay et al., 2008). Developed countries, such as Great Britain, have invested in promoting the use of educational technologies in the elementary and high school, and IWBs are becoming more and more popular at all levels of education. In part, this happened when the government budget financed the spread of IWBs in schools to get familiar with technology (Miller et al., 2004).

An IWB represents an important turning point in the classroom around the world and research by numerous authors suggests that if properly used they can have a positive effect on student results (Torff & Tirotta, 2010). IWB allows more frequent use of electronic didactic tools, since they can be used in the front of the classroom and thus show great potential for alternative ways of providing information. The main advantages of IWB can be increasing the visualization, motivation, and activities of students. Also, they contribute to faster and easier reception of information by students. IWB allows group discussions

and presentations because students do not have to write in the notes. They can collaborate in the process of solving many different tasks and gain quick feedback in interactive testing (Brecka & Oleksakova, 2013).

The main advantage of IWB is the easier preparation of teachers for a particular lesson, the ability to connect online and actively participate in distance learning. In addition to serving as a tool for presenting materials, the IWB represents the input equipment of the whole system. Therefore, the teacher can react much more flexible during this presentation, than during the traditional teaching of new educational content (Brecka & Oleksakova, 2013).

There are some common disadvantages of IWB. First of them is the higher price than a traditional board, or even higher than a combination of a projector and a projection screen. The school does not have enough funds to provide an IWB for each classroom. Also, this board is not used due to lack of time to design teaching materials, or due to limited sources of related teaching software. There is an IWB in the classroom that is not used due to lack of professional training for the IWB's functions and operation (Jang & Tsai, 2012). The surface can be easily damaged, and services and spare parts are expensive. It can happen that the user throws a shadow on the board and hide information too. One potential disadvantage is too much information on the IWB (Brecka & Oleksakova, 2013).

Usually, the most common problems with working with an IWB are technical problems, low level of teacher skills or even distrust for digital technologies. Other shortcomings that teachers mentioned were eye fatigue, the inability to work in parallel with two or more students (in the case of older boards), inadequate number of boards, an obstacle in accessing an IWB. A particular lack of material, as a serious problem, was confirmed in some studies focused on the research of pedagogical innovations (Brecka & Oleksakova, 2013).

IWB has a positive effect on student motivation, but some researchers warn that increased motivation in the use of IWB is correlated with the novelty factor and can eventually be reduced (Weimer, 2001). Some schools in London have announced that even in cases where teachers used an interactive whiteboard in different ways, increasing motivation was short-lived. Proper pedagogical training is of great importance for the maintenance of motivation. In order to increase students' motivation, an IWB should be used in the processing of specific topics and gradually engage in teaching and learning (Martin, 2007). Motivation and attention can be increased if students interact with the board themselves. It is reported that the use of IWBs in schools increases students' interest and encourages continuous attention (Glover et al., 2007). This is associated with the multimedia aspect of interactive whiteboards, because lessons become visually more stimulating (Slay et al., 2008). Also, students are offered new opportunities to publicly express their ideas, not only verbally, but also using graphic and other displays, using the IWB. In this way, they can get feedback from teachers and their peers and easily articulate with knowledge (Hennessy et al., 2007).

According to recent research, IWB can be used as a means of enhancing current didactic teaching practice, since they can easily be used as a replacement for classical school boards (Schuck & Kearney, 2007). It has been observed that there is a need for pedagogical change in interactive mode so that the application of the IWB would have the greatest impact (Miller et al., 2004). In cases where teachers are not aware of the characteristics of IWBs and how they can connect it with interactive pedagogy, often an IWB becomes nothing more than a teaching tool (Glover et al., 2007). The introduction

of an IWB into traditional didactic teaching styles can be easily achieved with little additional training, but it creates a completely new approach to pedagogy (Armstrong et al., 2005).

According to Smith et al. (2005), interactivity appears to be twofold - both technical and pedagogical interactivity. In order for the potential of IWB to be fully utilized, both of this interactivity must appear together. The problem occurs when teachers interact with the board, while students are observing or the teacher interacts with students or there is only interaction among students. In these cases, the board has a passive role. When combining these two dimensions of interactivity, an IWB becomes a tool that stimulates the thinking of both teachers and students (Šikl, 2012). Interactivity must exist between teachers and students, students and students, teachers and teachers (Glover et al., 2005b). Many teachers tend to dominate the lesson when using IWB, simply by using it for an interactive discussion with the entire classroom, without allowing students to interact independently with the board (Schuck & Kearney, 2007). When teachers do not realize that interactivity requires a new approach to pedagogy, IWB has a limited impact (Armstrong et al., 2005).

Teachers should strive to achieve an advanced pedagogical phase of interactivity, and view IWB as a means of indirect knowledge transfer. Perhaps the best and pedagogically the most effective way for IWB is to be included in the classroom in two steps. First, allow teachers to start only with a multimedia projector and a computer (Slay et al., 2008). When teachers implement multimodal teaching materials in the classroom, they move to the next step in which they include IWB along with interactivity. Teachers' readiness to transform their teaching styles from didactic to advanced interactive is essential. An IWB will have the greatest impact in classrooms with teachers who want to make this transformation. It is important to remember that good teaching remains such with or without technology. Only if teachers and students are engaged in understanding the potential of technologies as another pedagogical tool for achieving quality teaching, technology can advance pedagogy (Higgins et al., 2007).

The role of teachers must be streamlined to allow students to be more exposed and provide them with the opportunity to explore. He is not only a knowledge transferor and an evaluator as in traditional teaching, but also becomes an advisor providing information for learning planning and studying materials; an organizer that compiles the structure of activities on and off school time; a moderator who provides a flexible structure of work; guardian that allows information and student ideas to be saved or recorded (Šikl , 2012).

Teachers should develop self-confidence and practice their skills (Martin, 2007). They should also learn how to teach creatively, including a wide range of media such as video, animation, audio, graphics, and animation along with the text. In addition, this creative lecture should contain appropriate parts that can be prepared by students (Wood & Ashfield, 2008).

Based on the aforementioned characteristics of IWB, the implementation of this technology in the realization of entomological programme content was done. The intention was for the students to better understand this biology programme content and to adopt it permanently.

Application of interactive whiteboard in the realization of entomological programme content

In this paper, the application of IWB in the realization of entomological programme content in elementary school was presented. Two topics related to insects have been realized.

The first refers to the morpho-anatomical structure of insects and their division into groups. Second, relates to the role and significance of insects in nature (Appendix 1). Insects are the most numerous animal group in nature. They play an important role in nature, especially as pollinators (bees, bumblebees, flies, butterflies). Many of them are the main pests of agricultural and forest cultures (locusts, aphids, termites) or parasites of humans and domestic animals (cockroaches, fleas, lice, malaria mosquito). The declines of insect pollinators on Earth is closely related to the extermination of all other species. They are found in most food chains, so it's very important for students to understand their importance.

The realization of this contents in elementary school is different in comparing to their realization in high school. In high school, there are more concepts from this content which have to be explained, more comprehensive and detailed. Also, the acquiring knowledge should be at a higher level.

When the morpho-anatomical structure of the insects have to be presented, the basic concepts should be considered in the elementary school: body differentiation into segments, types of these segments. In contrast, in high school, there are more detailed explanation: for each segment, formations that are located on segments, their structure and function; the material of the cuticle, intestinal, respiratory, nervous, sensory, reproductive and excretory system. Fertilization is processed in the high school in detail, as well as the way in which the development takes place. In the elementary school, only the types of insect's developments and examples are mentioned. Division of insects into groups is also more complex. The role and significance of the insects in nature, in entomological programme contents in elementary school are similarly explained like in high school. But, entomological programme content in high school have more concepts about pollination.

In elementary school, this programme content includes concepts: insect pollinators, bees, bee products, the structure of insect pollinators colonies, pollinated plants and importance for human life and the existence of the most plants and animal species on the Earth.

The main learning outcomes for these topics in elementary school are:

• Cognitive domain

Students identify and name basic insect groups.

Students evaluate which characteristics are present only in insects in the animal kingdom, what do they have, or what other invertebrates do not have.

Students describe the role of insects in nature and their importance for man and other species.

Students create an image of the importance of the existence of insects as well as about their number.

Students assess which insects are harmful and useful to humans.

• Affective domain:

Students build their own view on the importance of the existence of insects from a medical and economic aspect.

Students develop their own responsibility towards insects as important factors of the natural balance and survival of life on planet Earth.

• Psychomotor domain:

Students build representative scheme of insects.

Students make posters and images related to the importance and protection of bees and other beneficial insects.

Learning this entomological programme content is very difficult and complicated for the most of students. Some additional factors in the difficulty and unpopularity of biology are the emphasis on theories and the lack of context, that is, the lack of consideration of the connection between science and everyday life and society (Tsaparlis et al., 2013). In order to adopt biological content in the best possible way, more senses need to be activated. This is achieved by using multimedia on the interactive whiteboard.

The multimedia program, which IWB contain, enables the creation of text with images, sound animations and movies. This is a clear and interesting way to present the information for students. Students are more attentive and more interested in following interactive lessons, better remembering content and more actively participating in accepting new knowledge. In addition, teachers can add sounds that are characteristic of this type of animals when processing themes related to animals.

On the IWB, entomological programme content is presented in the form of a concept map. These maps are very important for both high school and elementary school students. With their help, students remember and connect concepts better. In this way, students are enabled to understand the significance of different entomological concepts and relationships among them, and then apply it into learning. The purpose of the concept is not to replace content, but to explain the context and essence of the events in nature that learners should adopt, or to extract what is important, but also to connect knowledge and skills. Concepts are rules that are part of a more complex network or memory scheme (Tessmer et al., 1990). Concept mapping is an activity that can have numerous uses in a biology classroom. It can be used in planning, teaching, auditing and assessment of knowledge (Kinchin, 2000). Regarding whether the material is intended for elementary or high school students, the appearance of an IWB differs. An IWB for high school contains more text and main concepts, as well as concept maps.

IWB contains a lot of pictures and several videos. Some people need visual aids to help them learn. This means they learn best when they see drawings or images that represent concepts. Playing videos is a method for visualizing information and can be used to illustrate the concepts. Using videos to help students understand concepts can improve academic achievement and even attitude towards the subject of biology. The use of visual media can enhance understanding, especially the understanding of abstract processes that are hard to imagine. For example, in biology and entomology, there are many molecular processes that occur, which can not be seen by the naked eye. Students may be able to learn more easily if they see an animation of the process than if they only see drawings or scheme (Perry, 2013).

Also, regardless of the multimedia nature of the IWB, it should be combined with natural entomological insect preparations so that students can observe insects in natural size or natural habitat, draw them to the notebook and then mark concepts on them.

Discussion

Many researchers were concerned with the use of IWBs in biology. One of them, Veseli-

novska (2014), explored how biology teachers use IWBs in teaching, and the research was carried out on the theme of similarities and differences between animal and plant cells. The results showed that the academic achievement of students depends on how the teacher maintains the teaching of the specific content of biology. Unlike the lessons that begin with the frontal form of teaching in classes, classes that begin using interactive methods were more exciting and encouraging for the student. If laboratory experiments or slides are used in science teaching at the beginning of the class, it will attract more attention among students and increase their motivation. Oral lecture can be boring for students, and visual materials include understanding which words can not express and contribute to easily memorizing content. Using IWBs, students are offered real-life situations and the ability to directly solve the problem with the help of their skills. Students have more time and opportunities for practical experience, active thinking and reflexive use of knowledge. Also, teamwork encourages students to foster team spirit and leadership and use their interpersonal abilities in practice, while maintaining oral presentations gives them the opportunity to strengthen their mental reactions and presentation skills (Veselinovska, 2014).

There is a specific topic in biology that makes teaching and learning difficult (Oztap et al., 2013) have found that difficulties linked to topic “Cell division” are based on the way in which the content is processed. The results of the Yang and Wang (2012) research showed that teaching with an IWB is more effective than classical teaching in presenting topics from biology. Key concepts of this content can be better represented on the IWB, so it is easier for students to visualize and understand them and overcome these difficulties. Also, students claim that when they interact with the IWB, they get more involved and learn more easily (Torff & Tirotta, 2010). Yang and Wang (2012) argue that the key feature of IWB is high interactivity that allows teachers to have more contact and interaction with students.

Schut (2007) also worked on a research related to the use of an IWB in the realization of classes on the division of the cell, organic components, and genes. This research provided an insight into students perceptions while working on an IWB and indicated that the use of smartboards in teaching increased students participation by making them more active. Interaction with the board seems to increase their interest during the class. Also, students said that the visual properties of the IWB allow for more permanent retention of learning content in memory. The limitations observed by the students were small and were not considered as major disorders (Schut, 2007). Odner and Aydin (2016) conducted a similar research on the subject: "Photosynthesis: Energy Linking" and concluded that the use of IWB in teaching biological content was more effective on student achievement than teaching according to the curriculum.

Hennessy et al. (2007) conducted a research on the development of pedagogy after the beginning of the use of IWB in schools. Lessons in which research was made were food chains and gas exchange in the lungs. After analyzing the data, it has been shown that teachers show different approaches to encouraging and supporting activities in which students shared, evaluated and developed ideas using an IWB. Student manipulation of objects on an IWB was considered desirable, but together with pedagogical interaction, it was limited by the education system and subject culture, curricula and assessment frameworks (Hennessy et al., 2007).

Unlike other researches that focused on the interactive relationship between teachers and students, an IWB was used in the realization of a large number of biological content such as life cycle and classification of various organisms, food chain, healthy nutrition,

etc. It was concluded that the IWB can be used as information transfer tool and as an environment in which more individuals can have a discussion. In this way, it is possible to build knowledge together. The best way to achieve this is when a teacher is able to use the benefits of an IWB in active learning and support students in collaborative work and active dialogue (Warwick et al., 2010).

IWB allows teachers to devise and organize activities and lessons using a wide range of multimedia resources that encourage the cognitive and innovative potential of students in the learning process (Littleton et al., 2010). For example, chromosome structures can be presented using images, videos, or 3D models that help students build chromosome models. In addition, students can use IWBs to improve and facilitate the learning process. Teachers can design teaching activities for an IWB, which can help students to think and manage IWBs actively. For example, a teacher can provide incomplete charts about the cell division process that will populate students through the discussion on time. The teachers can also provide images to students on chromosome changes in each stage of cell division and encourage students to compare images in the right order and explain how the amount of DNA and chromosomes changes (Yang & Wang, 2012).

Conclusion and implications for the use of an interactive whiteboard

IWB offers a range of possible advantages in terms of facilitating the integration of a large number of concept and facts and offer new opportunities for encouraging multiple pedagogical strategies. Using IWB in the realization of entomological programme content creates a favorable learning environment for students as opposed to a simple lecture-based learning. It leads them to almost real-life situations and gives them an opportunity to solve problems with their own skills. At the same time, students have more time for practical experience, active thinking and reflexive application of knowledge. Additionally, presentation of entomological programme content on IWB offers them an opportunity to strengthen their mental and presentation skills.

These visual materials enable students to understand which entomological concepts and facts are very important and to remember them easily. They will no longer be adopted passively, and students will gradually with understanding participate in building new insights, make new ideas, independently perceive and organize information into a compact structure (structure of knowledge).

IWB has a positive impact on the motivation, perception, attention, behavior of students and their achievements. Knowledge transfer is simpler, and students are able to understand complex processes about insects in nature. Maintaining this level of motivation and interest can be achieved through a quality interaction between teachers and students, students and students and teachers and teachers.

The most effective way for IWB to be included in biology teaching is that teachers use a multimedia projector and computer at first, and then slowly engage interactivity into the process of teaching. Teachers should learn how to teach creatively and use a wide range of images, animations and concepts maps on IWB.

These processes can easily be achieved with little additional training (for teachers and students) for using IWB. In the future, training of teaching staff for the use of IWB in teaching biology is planned.

Acknowledgements: The authors would like to express their gratitude to the Ministry of Education and Science of the Republic of Serbia for the financial support (Project 173038).

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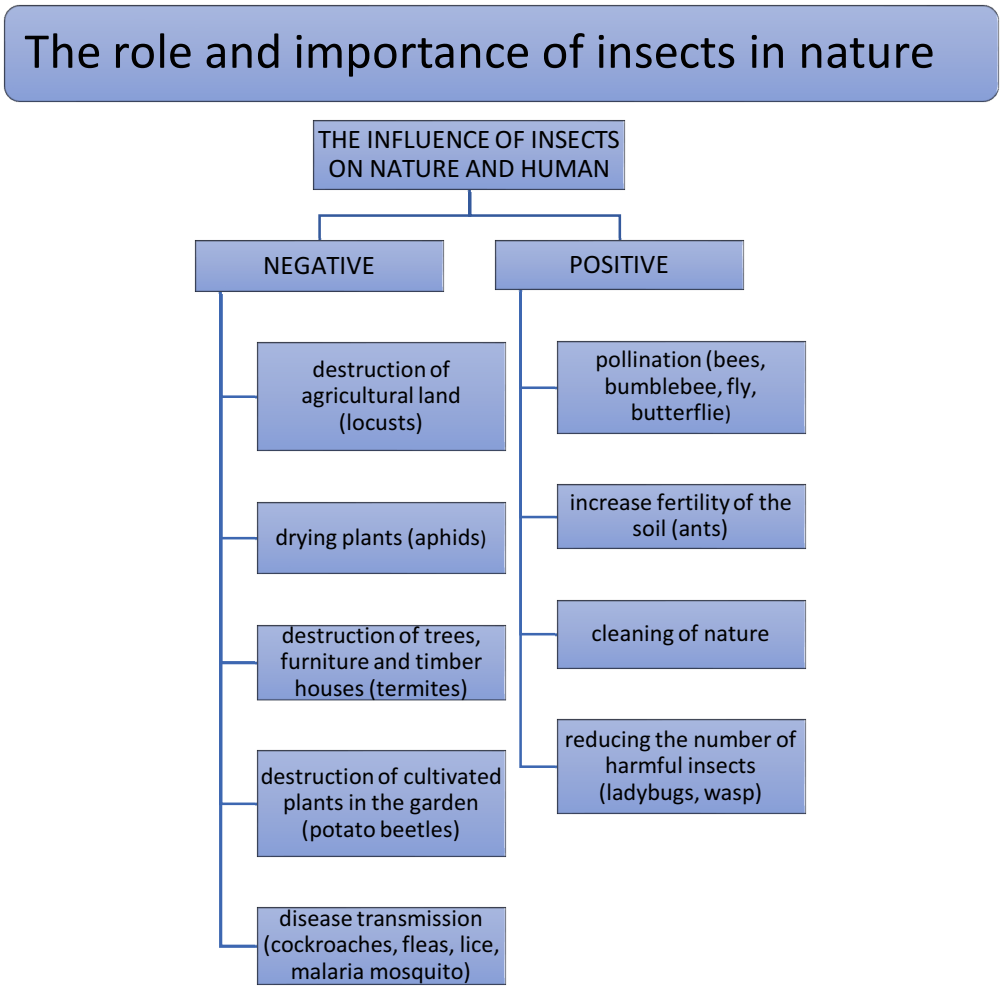
Appendix 1 - Application of an interactive whiteboard in the realization of entomological programme content in elementary school.



The direct benefit of insects for man

- honey, wax (bee)
- silk (silkworm)
- colors (aphids)
- medicinal substances

Biological action	Use of chemicals
•Reducing the number of harmful insects with the help of their natural enemies	•The poor solution because these materials are kept on leaves, fruits and soil, and can later be fed into the human body

Beneficial insects:

Honey bee

Butterfly

Ladybug

Bumblebee

Ants

Received: Febrary 11, 2018
Accepted: March 31, 2018