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NEW COMMUNICATION TECHNOLOGIES OF POWERPOINT PRESENTATION IN LEARNING PHYSICS

NOVE KOMUNIKATIVNE TEHNOLOGIJE POWERPOINT PREZENTACIJE U NASTAVI FIZIKE

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Abstract
In the frame of our national project "Development of Natural Science Competences" we have prepared physical educational materials, which main goal is to indicate better didactic strategies for the systematic development of pupils' natural science competences, one of them being the digital competence. In this contribution we describe two sets of representative materials, one for primary and the other one for secondary school pupils. The first set of materials is dedicated to the realization of group experimental work on the subject of electric circuits and the second set is a text- and web-based learning materials about optical phenomena in the atmosphere. A common feature of both sets of materials is that pupils are requested to prepare PowerPoint presentations of their new findings and present them to their schoolfellows. Our materials are supplied with instructions about a proper creation of slides and a suitable realization of the oral presentation.

Sažetak
U okviru našeg nacionalnog projekta „Razvoj prirodoslovnih kompetencija" pripremili smo obrazovne materijale za nastavu fizike, kojima je glavni cilj što bolje prikazati didaktičke strategije za sustavni razvoj prirodoslovnih kompetencija učenika, a jedna od njih je digitalna kompetencija. U ovom radu opisujemo dva reprezentativna seta obrazovnih materijala, jedan za učenike osnovnih i drugi za učenike srednjih škola. Prvi set materijala je posvećen eksperimentalnom radu sa temom strujnih krugova, dok se drugi set temelji na učenju o optičkim pojavama u atmosferi putem teksta i Interneta. Zajednička značajka oba seta materijala je u tome, da učenici moraju o novo stečenim znanjima pripremiti PowerPoint prezentacije i potom ih prezentirati svojim kolegama u razredu. Materijali sadrže točne upute za izradu slajdova kao i upute za usmeno izlaganje.

1 Introduction

The national project Development of Natural Science Competences which started in October 2008 is heading towards its final phase /**1**/. The project involves over 150 Slovenian experts in natural sciences and experts from supporting branches, such as mathematics, computer science and technology. The main goal of the project is to improve the quality and effectiveness of education and training in the teaching of natural science from kindergarten to secondary schools. Special attention is devoted to the systematic development of pupils' key as well as generic competences. There are several definitions of competences, but in general it can be said that competences are defined as a combination of knowledge, skills and attitudes appropriate to the context and as such necessary for the inclusion of young people into the world of work and study /**2**/. According to the European Parliament and the Council on key competences for lifelong learning, they are defined as follows /**3**/:

1. Communication in the mother tongue.
2. Communication in foreign languages.

3. Mathematical competence and basic competences in science and technology.
4. Digital competence.
5. Learning to learn.
6. Social and civic competences.
7. Sense of initiative and entrepreneurship.
8. Cultural awareness and expression.

All of them are considered equally important because each of them contributes to a successful life in a knowledge society. However, especially the third competence from the list refers directly to natural sciences, although other competences from the list are also interconnected with science. For example, there are numerous possibilities within science lessons, how the pupils can acquire the digital competence, which in general includes the use of computer and other Information Communication Technology (ICT) tools /**4**/, /**5**/.

In addition to the development of the abovementioned key competences, which should be fostered during all school subjects, the project is even more oriented into the systematic development of a specific set of generic competences, which refers more directly to natural sciences and have a narrower meaning as compared to the key competences listed above. Those competences were defined by the Australian Education Council /**6**/. Representative examples are: 1) ability of collecting information, 2) ability of analyzing and organizing information from literature, 3) ability to synthesize conclusions, 4) implementation of theory in practice, 5) care for quality, 6) ability to work with others in groups, 7) verbal and oral communication etc.

In order to systematically promote the development of key as well as generic competences and raise the scientific literacy among pupils, we prepare expertise and modern teaching materials, test them in school practice and analyze them afterwards. Due to the fact that the curriculum is more or less set, the main novelties of our materials are not new contents but instructions and directions for teaching methods which promote the evolution of competences. However, some efforts have still been made to incorporate also new and modern scientific achievements in primary and secondary schools /**7**/. In the paper we present two sets of representative physical educational materials, one for primary and the other one for secondary school pupils. The indicated didactic methods give rise especially to the digital competence, although other competences such as the ability of analyzing and organizing information from literature, ability to work with others in groups and verbal and oral communication are being trained as well. Development of these competences is crucial for the successful inclusion of young people into the world of work and study.

2 Contents of the materials

As announced, here we describe two sets of representative materials for physics lessons. The first one is devoted to the realization of group experimental work about electric circuits and is intended to physics lessons in the 9th year of primary school (age 14). The second set is a text- and web-based learning materials about optical phenomena in the atmosphere and is intended for physics lessons in secondary schools (age 15-17). Further we briefly describe the contents and the didactic methods for both of the materials.

2.1 Electric circuits

Electric circuits abound in today's world. They are basic parts of all electronic gear from TV sets, computers and even cars. Besides, several scientific measurements from physics to biology and medicine make use of electronic circuits. It is therefore of great importance to introduce the topic and its basic principles already to pupils in primary schools. The practical content of the material proposes experimental work in groups, which has been recognized as a very thriving strategy for introducing the ideas of resistors connected in series and in parallel, especially at elementary level /**8**/,
/**9**/. We have thus prepared five worksheets, one for each of the group, with guidelines for the realization of different experiments designated to give pupils practice in building and analyzing circuits. Some groups consider resistors connected in series whereas other groups scrutinize the case where the resistors are connected in parallel. In certain experiments the resistors are replaced with lightbulbs. Nevertheless, neither the contents of the experiments nor the experimental work in groups are the central point of the materials. The main idea is that after the experimental work pupils are required to create PowerPoint presentations with their results and new findings and pre-

sent them afterwards to their schoolfellows. In order to ensure that the slides are prepared properly we supplemented the materials with an exemplary PowerPoint presentation, which is executed by the teacher at the beginning of the lesson. Along with general instructions special attention is devoted to the representation of experimental setups, numerical results and schemes – substances that appear rather common in natural sciences. Some examples of slides from the exemplary presentation are shown in

Figure 1.

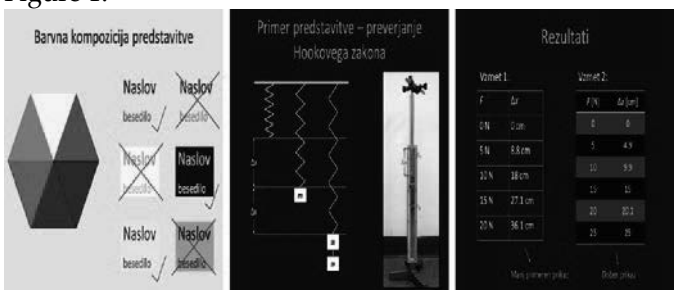

Figure 1. Representative slides from the exemplary PowerPoint presentation on the basis of which the teachers hand pupils instructions about the proper creation of slides.

The realization of the course presumes two hours of lectures. In the first hour the teacher first gives a lesson on using PowerPoint effectively, which is based on the prepared exemplary PowerPoint presentation. He lays stress upon suitable preparation of the slides and emphasizes the characteristics of a good oral presentation. This activity takes 10 to 15 minutes. After that experimental work in groups is taking place, which lasts about 25 to 30 minutes. At the end of the first lesson the teacher gives some further directions about the creation of presentations and helps the pupils to organize. The preparation of the slides is considered as a homework assignment. In the first 15 minutes of the second lesson the pupils finalize their presentations. After that each group presents their work to the classmates.

2.2 Optical phenomena in the atmosphere

What is in common to phenomena such as the rainbow, fata morgana and the green ray? First of all we can say that these are all very interesting and astonishing occurrences, which make us aware of the extraordinary beauty that only nature can offer. But from a physical point of view these are all optical phenomena in the atmosphere which occur when certain circumstances are fulfilled. Despite the fact that different events manifest itselves in different layers of the atmosphere and that different physical mechanisms are involved in their formation, all of them can at least qualitatively be described by elementary laws of optics /**10**/. For that very reason we decided to develop educational materials on the subject intended for physics lessons in the third year of the secondary schools. Even though that the topic is not in the curriculum, it enables the pupils to deepen and expand their knowledge on optics. However, the main goal of the materials is not the introduction of interesting contents to the pupils, but in the teaching method and the subsequent development of competences. Pupils are separated into five groups and each of them receives worksheets on a different subject. On the basis of the contents on the worksheets and on the quoted web pages, pupils examine their topic, prepare PowerPoint slides and subsequently present it to their schoolfellows. Furthermore, we prepared a series of instructive schemes and collected several pictures and photos which the pupils implement in their presentation and thus enable them to efficiently explain their new findings. Some representative examples of the developed schemes are shown in Figure 2. Moreover, the pupils are meant to retrieve additional information and figures from the web. The worksheets are therefore supplemented with links as well as with instructions on how to effectively find the desired information via web search engines. Materials are meant for two hours of lectures. Similar as with the materials on electric circuits, the teacher first gives a lesson on using PowerPoint effectively, which takes 10 to 15 minutes. Then, pupils split into five groups and each groups works then on a different topic. On the basis of the worksheets and information from the web the pupils learn and prepare slides. This activity lasts till the end of the first lesson. In the first 15 minutes of the second lesson the pupils finalize their presentations. Afterwards, each group presents their findings to the schoolfellows.

Figure 2.

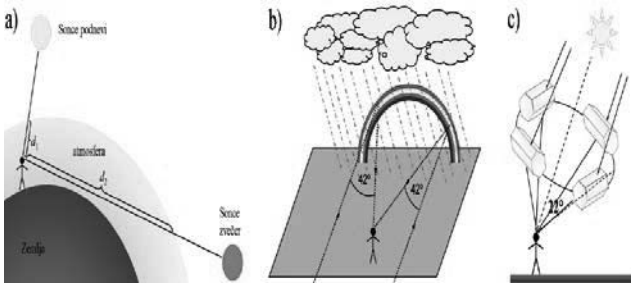

Figure 2. Examples of instructive schemes which the pupils include in their presentations and thus provide physical explanations for the phenomena such as colors of the sun (a), formation of the rainbow (b) and halos (c).

3 Acquisition of competences by pupils

The general goal of the physics education is that pupils learn about the main physical concepts and theories related to the phenomena from daily life, and assimilate the knowledge about the nature. The focus in physics is not only on achieving the general goals, but also on developing the natural sciences competences. The physics does not put in centre only the development of key competences in science and technology, but also the development of digital competence, where pupils gain the knowledge and skills by using the computer as well as measuring devices. Knowledge assimilated in physics, is directly transferable to the use of modern technological tools and measuring devices, which function is associated with the digital technology and computers. Therefore, the physics education is becoming increasingly intertwined with the use of modern information and communication technology, which is now part of pupils' lives /**11**/. Because the technology is widely spread it is necessary to teach pupils how to proceed with it and how to use it /**12**/.

Specifically, by using the materials *Electric circuits* and *Optical phenomena in the atmosphere* pupils develop the following competences:

- Digital competence: the digital competence is developed while pupils design PowerPoint slides and search for the information and figures on web.
- Ability of collecting data and the selection of data: working methods that provide the study of the content from the worksheets and from the additional data from the web enable pupils to learn how to select data and combine the collected data into the meaningful whole.
- Ability to work with others in groups: the material provides the work in groups. The important things of group work are the adequate division of tasks and concerted functioning which lead to the best results – illustrative slides and appropriate and clearly presented presentation.
- Ability of organizing and planning of the work: pupils are divided into groups, where the group should organize their work in the most economical way – the best results in the given time. The organization of work plays an important role in the group work, where it does not correspond only on the division of tasks to individual members of the group but also on the simultaneously carried out tasks where it is possible. Pupils develop the competence of organizing and planning of the work during the designing the presentation slides.
- Verbal and oral communication: the acquisition of the verbal and oral communication is more prominent while pupils write the text on slides and prepare the presentation speech. Of course competences of verbal and oral communication are developed all the time during using of the material, but on the above mentioned part are more exposed.

4 Materials in school practice

The evaluation of the materials *Electric circuits* and *Optical phenomena in the atmosphere* is based on the results taken from the pre-questionnaire and a questionnaire, and teacher's observations for each group of pupils. Questions in the questionnaires are focused primarily on the use of PowerPoint, making slides and the use of them at the presentation. Teacher's observations are the instrument for the evaluation of pupils' presentations and the level of development of digital competence.

The material *Optical phenomena in the atmosphere* is being tested in the period from April till June 2011, so that till now we have not received any evaluations from the teachers.

The material *Electric circuits* has been tested by 90 pupils from three different primary schools. The sample represented a predominantly rural population with mixed socioeconomic status. The results of the pre-test show that 84 % of pupils had already use the PowerPoint. 47 % of pupils self-assessed their knowledge about PowerPoint as good, 45 % as average and 8 % as negligible. Most of the pupils on the pre-test agreed that PowerPoint presentation should include introduction, core and conclusion. 10 % of pupils also mentioned that the PowerPoint presentation should

include authors, title, keywords, abstract and references. 52 % of pupils knew that the appropriate number of indents is till 9. The most common pupils' advices for a designer of slides written on pre-test were: make beautiful slides, write maximum 9 indents, write only keywords, use more images than text and use a large font. Pupils wrote the following advices for a speaker using the PowerPoint presentation: tell the speech by heart, the slides only guide you through the speech, use the figures and graphs as an illustration of the oral described phenomena, experiment or data.

The results of test show that the work with the material *Electric circuits* by using PowerPoint was interesting for 95 % of pupils. 97 % of pupils agreed that the material about electric circuits was well prepared. 70 % of pupils did not have problems with the use of PowerPoint. Some of the pupils were novice users therefore they had some problems by using its functions. Few pupils had problems with editing the figures and adding animations. 53 % of pupils have learned something new, while 47 % of pupils said that there is nothing new for them. The mentioned new learned things were linked to the editing of the figures and tables, the meaning of colors of the background and the font, the general knowledge about the contents of the presentation and the length of the presentation and the preparation of a speaker for the presentation. For pupils the PowerPoint is an interesting tool for during the physics lessons. 72 % of pupils self-assessed their knowledge as good after the activities provided by the materials *Electric circuits*, 25 % as average and 3 % as negligible. If we compare the percentage of pupils who self-assessed their knowledge on test as good, it is mush higher than on pre-test (pre-test: 47 % good, 45 % average, 8 % negligible).

Teachers report that 80 % of pupils took into account all the suggestions for designing the slides and made appropriated slides. 20 % of pupils had problems with the composition of colors on the background and the color of font or inappropriate chosen figures or with the presentation of experimental results or the whole sentences written at one indent or with the formation of the conclusions. The oral presentations were successfully carried out by 60 % of pupils. 40 % of pupils had difficulties concerning the reading of the presentation speech or the lasting of the presentation was longer than the estimated time. The teachers expose that these problems are not the consequence of the lack of knowledge but lack of experiences with the oral presentations. Moreover, the general remarks from teachers were: the pupils who attended the course *Computer sciences* were quite familiar with the PowerPoint, others have some difficulties. The new learned things by pupils were connected with the composition of colors, the length of text on slides, the presentation of experimental data and the formation of conclusions.

Teachers agree that the material *Electric circuits* is well prepared, the instruction for the preparation of the PowerPoint presentation is written in a very detailed way and it is also very helpful for novice learners. Worksheets include all basic information for the tasks and consequently for the necessary understanding of the phenomena. The use of the tool such as PowerPoint makes the physics more attractive and pupils more self-confident for the oral presentations of their work in general, not only for the physics experiments. However, the information given from teachers and pupils shows that the material is well prepared and enables the step further in the acquisition of the digital competence.

5 Discussion

In today's world knowledge and technology are becoming outdated rapidly and updated constantly. This knowledge explosion cannot be solved by adding more courses. Therefore, the responsibility of teachers is not only to teach the pupils with the particular or professional knowledge but also to help them develop successful lifelong learning skills, making them competent for functioning in the modern society. Nowadays it is definitely of great importance that pupils evolve the abilities of oral and written communication, the ability of collecting information and working in groups. Due to the growing aspiration for flexible and better educated digitally competent citizens it is also of particular importance that the pupils learn to use the computer and other information communication technology tools. The presented sets of materials represent nice examples how the development of all of the abovementioned competences can be encouraged during physics lessons, with special emphasis on the digital competence. If we are even more specific, the materials introduce to pupils PowerPoint as a useful tool for the design-

ing of the presentations. While searching for additional information and figures pupils also confront with the web browser. Our results reveal that the presented materials indeed foster the digital competence. Actually, we have observed the increased proportions of pupils who self-assessed their knowledge about PowerPoint as good on the test (72 %) comparing to the pre-test (47 %).

Furthermore, we found that the pupils are quite well acquainted with PowerPoint, which is definitely related with the fact that the work with MS Office is noted in the current curriculum of the computer science in primary education as well as in the curriculum of the informatics in secondary education. However, it turned out that the pupils lacks of expertise on more advanced and specialized handling with PowerPoint. Especially activities which are typical for natural sciences, such as handling with figures and explaining experimental setups, drawing schemes and presentation of numerical data seems to be problematic. Moreover, all teachers pointed out that most of the pupils had difficulties by their oral presentations, mainly because of the lack of experiences. Our findings thus suggest that pupils should use the PowerPoint more often and make oral presentations as much as possible. It is a fact that only practice will help pupils build the self-confidence regarding the oral presentations. The other important finding is that only the awareness of difficulties with the presentation of the experimental measurements and results will bring the pupils' digital competence on higher level.

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Notes

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