DEVELOPMENT OF BASIC COMPETENCES IN SCIENCE AND TECHNOLOGY IN MINORITIES WITH LANGUAGE-INDEPENDENT COMPUTER SIMULATIONS

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Abstract: With the growth of multimedia computers became more important than ever. Internet became linking media that connects people. But circumstances are far from being perfect. On one hand, we have circumstances similar to those in Eden, where students can use various didactical tools, and on the other, students are still left with the white chalk and black board. The main purpose of this article is to present the problem of accessibility of multimedia to users that have limited knowledge of foreign language (in most cases English).
On the Faculty of Natural Sciences and Mathematics we developed interactive computer simulations of biological laboratory exercises. Simulations are equipped with translational support that enables users a translation into a chosen foreign language. The simulations Osmosis and Greenhouse effect are presented in this article and can be used by minorities in Slovenia as well as by anybody else who is not fluent in Slovenian language.

Keywords: language-independent computer simulations; computer based laboratory exercises; osmosis; greenhouse effect; minorities' education

Introduction

In the last years internet is in full growth and consequently became very important educational tool (Mayfield & Ali, 1996; Fancovicová et. al, 2010). Students find it important for searching the references, writing papers and communicating in student groups (Lagier, 2003). There have also been researches on positive development the scientific competences with the computer supported laboratory work (Špernjak & Šorgo, 2009) and multimedia (Starbek et al., 2010). Students were active and generally like the new technology in the laboratory.

Along with the new technology, English language was introduced. Especially in the beginning the need of knowing English was of great importance. In the article we presented the foreign language as the main barrier when using technology for educational purposes. Insufficient knowledge of English language and lack of educational materials or outdated information in Slovene language are main reasons why the technologies are not used as often as we wanted them to be (Šorgo, 2003; Puhek & Šorgo, 2009; Puhek & Šorgo, 2010).

Manten (1974) detected the fall of scientific works in German and in French and the rise of articles written in English. Today this trend continues and it is clearly seen when a professor wants to publish a scientific article in a well known journal. Top ten journals within biology and education topic are written in English. Another eloquent proof is when a student is applying for a student exchange (Socrates Erasmus, Leonardo da Vinci), then the student usually needs to know at least English or even better the language of the country he/she is applying for. Goodman (2008) found out that Spanish students more likely saw the language as a barrier than English colleagues. Šorgo (2003) declared that the problems of not understanding the foreign language decrease with the student's years of studying. In Slovenian secondary school ("gimnazija") students of the last grades had least

problems with the understanding foreign literature than the freshmen. In primary school, when students are even younger and have less foreign language knowledge, the problems of understanding can get insurmountable (Puhek & Šorgo, 2009).

There are many possibilities to overcome those obstacles. One of the possible solutions is the usage of translating tools and dictionaries (Schloman, 2000), or the usage of materials without text (pictures, silent movies, animations without text), where language does not present a problem (Puhek & Šorgo, 2009).

On the Faculty of Natural Sciences and Mathematics we developed interactive computer simulations of biological laboratory exercises. The simulations Osmosis and Greenhouse effect were equipped with translational support that enables translations into a chosen foreign language. In this article presented simulations can be used for practising before or after the actual laboratory work or as a virtual laboratory work. The only equipment the user needs is a working computer and a person to translate them from the basic language (for example English) into the desired language of the target group. That makes them possible teaching tool for developing countries or for the minorities. Magos (2007) pointed out the positive effect of usage of minority's mother tongue in the classroom. Students find the atmosphere relaxed and beneficial for the learning process. It was also described that the multicultural approach towards learning has brought diversity and cultural into the classrooms (Bochaca, 2009).

Methodology

The main aim of the research was to point out the language as an important barrier in the field of education. We carried out a comparison of the hits that we got in Google in different languages. To make a credible comparison we translated words in different languages and then searched for the hits. For the search with Google we used the option advanced settings to change the language, in which the hits should be found. Then we typed the translated words in the inputs for word phrases. Option word phrases were used, because in other case results covered all words, what was in most of the cases not correct. Finally, we inserted the gained hit numbers into the table.

The bases for the development of simulations were the computer based laboratory exercises that were carried out with Vernier's sensors (Vernier's data loggers). The results were consequently presented in a graph. Every simulation is an independent program (.exe) with a similar basic structure. The programming language is Microsoft VisualBasic 6.0. The reason for creation of the programs as individual programs was as followed; they are universal, because they do not need extra installations on the computer, and are therefore easier to be spread among users. They are also supposed to work on different operating systems. The user does not need the access to internet to start the simulation. Therefore these simulations are appropriate for countries that have less developed World Wide Web connections. Before the usage of simulations parameters have to be set and then run with the command "Realize".

Findings and Discussion

The research was carried out in two parts. In the first part (with the help of Google hits) we pointed out the problems of understanding of the learning material in foreign language. In the second part we presented our solution to overcome the language barriers. In the future the following part of the research will cover the testing of the simulations in practice.

What does uncle Google says?

Probably not only in Slovenia a popular phrase exists; if you do not know an answer to a question, colleagues directs you to consult "uncle Google". Internet became one of the crucial educational searching tools and it is not unusual anymore that the students found it more useful than printed ("old fashioned") resources (Mayfield & Ali, 1996). With the internet, users can search for all kinds of information in seconds, which is impossible when searching through books. But things are

not as simple, as they seem on the first glance. When users pore over a particular educational information, it can be easily seen that the quantity of information vary from language to language. Here it must be said that things do not appear equal anymore, if students are not perfect in English.

The main goal of our research was to compare the search hits from Google in different languages (Table 1). We expanded the research from Šorgo (2003) and Puhek & Šorgo (2009). As we expected, in general we found increase in number of pages in all languages, but also some exceptions were defined. We realize that it is hard to make decisions based only on searching hits, because internet is almost a living being: searching algorithms are changing all the time, users can publish what they like (Puhek, Šorgo, 2009), some words are same in different languages (Šorgo, 2003), blogs and forums do not give you the desired hits (Puhek, Šorgo, 2009).

With approximately 500 million users (Miniwatts Marketing Group, 2009), official internet language is still English (Šorgo, 2003). When examine the numbers from Table 1, it is clearly seen that even hits from Spanish as the third most spoken language in the world cannot be compared to English. When searching for information in a not widely known language as Slovenian is (2 million citizens), or even smaller countries (some dialects), the number of hits decreases rapidly.

Table 1. Hits from Google of the words in different languages for 2003, 2009 and 2010.

WORD	**LANGUAGE**	**HITS (2003)**	**HITS (2009)**	**HITS (2010)**
Biology	English	4.780.000	166.000.000	192.000.000
Biología	Spanish	/	6.950.000	9.020.000
Biologie	German	/	5.670.000	4.440.000
biyoloji	Turkish	/	2.310.000	3.520.000
bioloģija	Latvian	/	216.000	182.000
biologija	**Slovenian**	**10.800**	**178.000**	**238.000**
Heart attack	English	667.000	47.200.000	58.900.000
ataque al corazón	Spanish	/	4.130.000	5.350.00
Herzinfarkt	German	/	1.080.000	1.110.000
kalp krizi	Turkish	/	1.320.000	1.740.000
sirdslēkme	Latvian	/	51.300	65.600
srčni infarkt	**Slovenian**	**137**	**52.600**	**127.000**
Eustachian tube	English	10.600	806.000	332.000
trompa de Eustaquio	Spanish	/	30.400	118.000
Eustachi Röhre	German	/	8.070	11.300
östaki borusu	Turkish	/	11.700	58.000
eistāhija kanāla	Latvian	/	5.220	6.230
evstahijeva cev	**Slovenian**	**5**	**5.430**	**7.670**

With more than 400 million internet users (Miniwatts Marketing Group, 2009) the Chinese would be very interesting language to be included in our research. In that case Google would not be the appropriate searching tool to use, because the problems with government and major language problems would be even harder to overcome.

Language-independent Computer Simulations

Two different language-independent simulations were developed. In the simulation with the title Osmosis we simulated a cell, which was in the computer supported work made out of plastic tube. We put that cell into different osmotic solutions, with different quantity of salt (NaCl): isotonic, hypotonic and hypertonic. The central part of the simulation was the passive movement of the water (solvent) through a semipermeable membrane and not the ions. In the second simulation we examined the impact of greenhouse gases on the heating of the atmosphere.

Osmosis

The process of osmosis was presented as the natural process in two variations: graphically and as an animation. One of the reasons why we created simulations is the attractiveness for the students that are learning biology. The simulation vividly presents to its user what impact does the process have on the cell (in our research only plant cells were used). The cell can be presented in three different environments (isotonic, hypotonic, hypertonic), which has to be chosen by the user from the menu on the right. Dependent on which solution is chosen, the impact on the cell varies. If the checkbox "show graph" is checked, the animation is also demonstrated with it. If the user chooses the first option among the solutions, the cell does not change a lot, because in the isotonic solution the water enters and leaves the cell in the almost same quantity – the graph stays linear. If the user chooses the second option – a hypotonic solution – the simulation shows how the vacuole increases; the graph is falling. The third option that can be selected is a hypertonic solution where the water leaves the cell; the curve on the graph rises (the graphs present the conductivity in the dependence of time). One of positive options of the animation is that the students can predict the result of the experiment without knowing the actual results. The hint is given through a key question, in the case of osmosis the students have to answer the question what passes into and out off the cell – solvent or solute. The addition to the original simulation is the option for translations in other languages. The menu can be reached with the button "Translate" and is built out of text inputs that enable the user to translate words into desired language (Figure 2). We also included the button to return to the basic language. This button serves as a safety tool, when user gets the program in a language that he/she does not understand or for example when a student inserts something unwanted into the text frames.

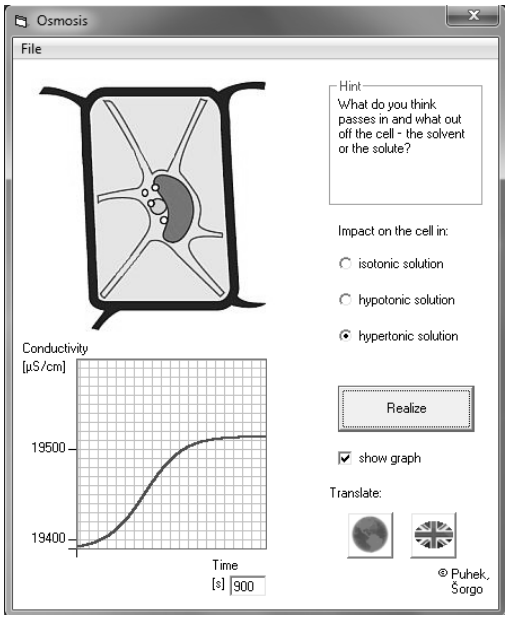

Figure 1: Basic view of the simulation Osmosis.

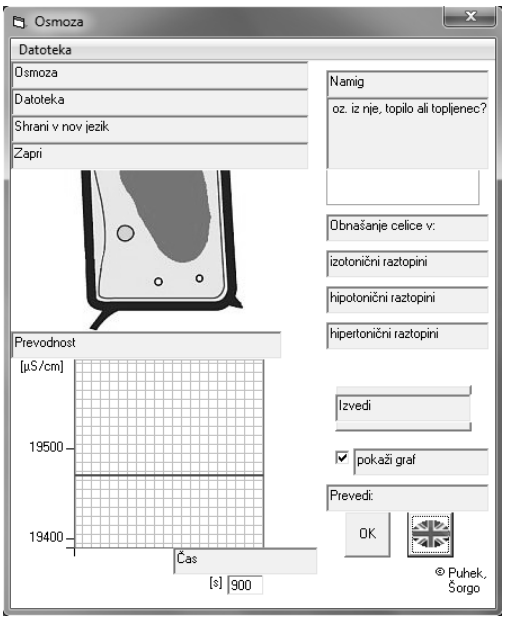

Figure 2: Translated version of simulation Osmosis

(target language: Slovenian).

The Greenhouse Effect

In the picture the arrows are used to present the heat that is produced by the radiation. The arrows are pointed to the Earth and into the sky, which simulates the radiation of the sun. In the simulation the user can choose between »normal state« and »greenhouse effect«. In the first option, the procedure is described, where the greenhouse effect is not present, which means that the optimal warmth on the Earth surface is preserved by letting some of the warmth created by the sun transmit back to the atmosphere. Temperature on the graph reaches around 35 °C. When the atmosphere is thickened by greenhouse gases (CO_2, methane, water steam) – this is simulated through an additional atmosphere layer – the sunrays cannot exit and therefore reflect back to the surface of the Earth. The curve on the graph shows 50 °C, the thermometer turns red. As it is the case in every simulation we created, the user can check the checkbox whether to show graph or not. The user can also use the hint to establish the point of the animation.

Again the part for translating into other languages can be reached with the button "Translate". The user can translate the words into desired language with changing words in the text inputs (Figure 2). We also included a button that enables the user to return the program to the basic language. Finally, simulation includes the menu for saving the program into the new, changed version.

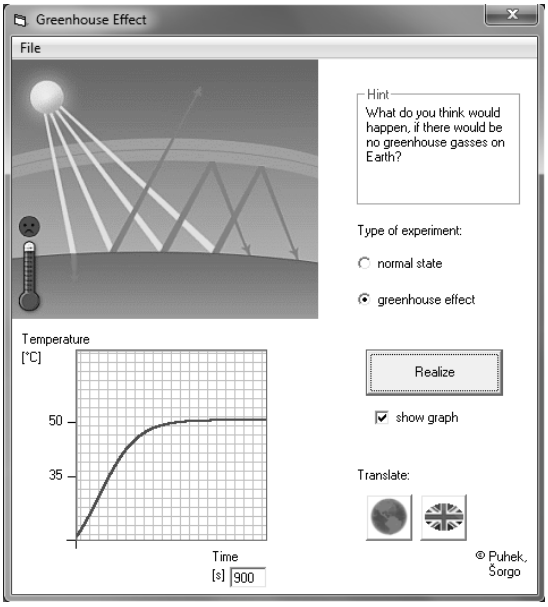

Figure 3: Basic view of the simulation Greenhouse effect.

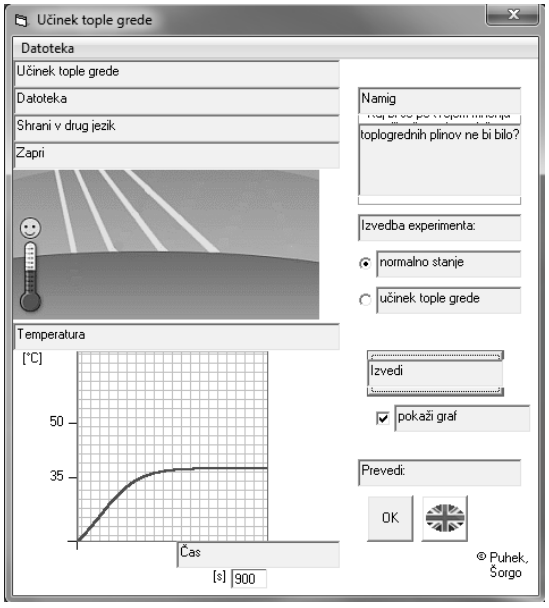

Figure 4: Translated version of simulation Greenhouse Effect (target language: Slovenian).

Conclusion and Recommendation

The main goal of our simulations was to create the included menu for translating into new languages. Despite previous versions (Puhek & Šorgo, 2009) we developed the menu for saving the changed version into the new one. The idea of our work is to develop a product that can be dispatched through the World Wide Web (or with other media like USB sticks) and can be used by everyone, especially by the users that can hardly find educational tools in their non-English languages. Despite some disadvantages of that procedure, as the fact that still somebody needs to know the basic language and translate it into desired one, we created an option for more users to use the simulations as if the simulations were only in English. Our simulations do not even need the internet connection, so they can run almost everywhere.

When the users translate the simulations and save them into the chosen language, pictures remain unchanged. That is why the simulations can be used even in multinational classes, because everybody can work with the didactical tools in the own language. For example in eastern part of Slovenia classes can be held in Slovenian and simultaneously in Hungarian. In that case the multilingual work depends from the abilities of the teacher and not from the didactical tools anymore.

In the future we would like to develop more simulations and test them in the classes around the world.

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