PROBLEMS
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80

WHAT IS THE TENDENCY IN BIOLOGY VIRTUAL FIELD TRIPS? THE CASE OF MARIBOR ISLAND TRAIL

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Abstract

There is no doubt any more that virtual worlds are suitable for school environment. It was shown by various researchers that they can contribute in supplying students with additional information, help them to visualise subjects, respond with answer on demand or even in some cases supplement the real materials. Based on the real experience, the virtual field trail Walk on Maribor Island was developed for biology and natural science classes in lower secondary school. The trail is presented through eight exercises that differentiate not only in theme, but also in difficultness, fun, background idea etc.
In spring 2011, 133 eighth grade students worked on the virtual field trail during the biology class. After the work on exercises, students were asked to analyse the exercises regarding the level of difficultness, level of interest and level of proficiency. The main aim of the study was to present the tendency in biology virtual field trips that should be taken into consideration before the development of new exercises.
Key words: *biology, education, field work, virtual field trips*.

Introduction

Science can be described as composition of observation, measurement, analysis, hypothesis testing and experimental work. To assure perfect understanding of how the organisms function and interact with each other and the environment, hypothesis testing and experimental work need to be performed radically, because these two components are extremely important in the biological science (Stafford, Goodenough, & Davies, 2010). The fact that some students do not necessarily require the hands-on or experiential learning provided through digital resources to comprehend the concept of experimental design, but can learn from theory-based lectures, is quite interesting (Stafford et al., 2010). Teachers pointed out numerous logistical and instructional problems when dealing with real field trips, which could be solved by using the virtual field trips (Tuthill & Klemm, 2002). Moreover, the execution of the required timetable of the real field trips was in some cases impossible. By using different digital resources as VRS and others, teachers are no longer dependent on the unstable nature, place and time (Stafford et al., 2010). The results of the research showed that IT is primarily used for processing and representing of the data, and only secondarily for motivation, interpretation and quality management (Rebolj, 2011). Educational media is supposed to successfully convey information to learners. By changing the structure, content and navigation of the classical manuals into digital, interactive manuals it was proven that authoring and evaluation can form an improved instructional effectiveness (Holmquist & Narayanan, 2002). It was stated that schools do not

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Volume 50, 2012

need more technology such as computers and platforms, but need to use their advantages to achieve outstanding results (Rebolj, 2011).

Based on the good practices, researchers applied various concepts for the successful development of educational virtual tools. Developers should in tools enhance the usability of gaining attention, informing the learners with the lesson objectives, activation of motivation, simulation of recall of prior learning, providing learning guidance with feedback, enhancing retention and learning transfer (Gagne, 1985; Stemler, 1997). Despite that interactivity and multimedia increase the motivation, overuse of both can be distracting. Simplicity is one of the most important goals of interactive multimedia software design (Stemler, 1997). Austin (2009) stated that text positioning and motion distraction is accounted for the inferiority of transfer test performance in certain multimedia conditions, where bad display design can split attention, increase cognitive load, and reduce transfer learning. Among other characteristics, it was also found that competition between thematic and taxonomic relationships and difficulty in forming hierarchical categories could affect the students learning skills (Sung, Chang, & Lee, 2008).

Purpose of the Study

The main aim of study was to search for the tendency in biology virtual field trips (on the case of trail Walk on Maribor Island) that should be taken in consideration before development of new exercises. In that manner of study the two main research questions that tried to be answered:

a) Do students find all virtual exercises equally interesting?

b) Which factor plays the most important role in the level of interest for the exercises of the virtual trip to Maribor Island?

Background - Virtual Field Trail Walk on Maribor Island

Virtual trail Walk on Maribor Island (http://e-ucenje.sinergise.com) was developed together with real trail that was placed on the island itself. The trail (Table 1) consists out of eight exercises: 1) The preservation area Maribor Island; 2) Biodiversity; 3) How old is a tree? 4) Deciduous trees; 5) Illumination; 6) Coniferous trees; 7) pH-value and 8) Animal adaptations. During the development the simulation of real work was considered and the tendency to use exercises also as separate work. All exercises could be also performed in virtual or in the real manner.

Table 1. Explanation of the exercises from trail Walk on Maribor Island.

Exercise	Level on Anderson and Krathwohl's taxonomy	Playful-ness	Interactivity	Exploration	Percent of efficiency
1. The preservation area Maribor Island	Remembering	☆	☆	☆	/
2. Biodiversity	Analysing	☆☆	☆☆☆	☆☆☆	34.5
3. Dendrology	Applying, understanding	☆☆	☆	☆☆	70.5
4. Deciduous trees	Remembering	☆	☆☆	☆	51.0
5. Illumination	Understanding	☆	☆☆	☆☆	79.0
6. Coniferous trees	Remembering, applying	☆☆	☆☆	☆☆	63.5
7. pH-value	Remembering	☆	☆	☆☆	67.5
8. Animal adaptations	Analysing	☆☆☆	☆☆☆	☆☆	54.0
Note: ☆ - small, ☆☆ - medium, ☆☆☆ - large					

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Exercise 1 – The Preservation Area Maribor Island

The first exercise was developed to present the island to visitors and to inform them about conscious ways to visiting the real trail in nature preservation. In the first part, students move around the interactive map on the Java widget. After the virtual visit, they had to finish the quiz-alike exercises, where students need to name the sign they would also found in nature.

Exercise 2 – Biodiversity

In the exercises students simulate the method of identifying plants with the square plots. Firstly, students choose one of the two areas (meadow or forest) to zoom it. The main window of exercise appears (Figure 1), where different plants are automatically coloured differently. Because it would be illusory to expect from students to name all plants, they only have to count the different colours (species from picture) to get the data for a graph. Even that method is generalized; students through exercise see how biodiversity works.

Figure 1: The basic view of exercise 2 – Biodiversity.

Exercise 3 – How Old is a Tree?

In the exercise two methods of detecting the age of a tree from a stump are presented. Students are put in shoes of dendrologist, where they have to count the tree-rings. To finish the work, firstly, they have to name the wood parts through input window. Later they count the tree rings and compare the result with a math calculation.

Exercise 4 – Deciduous Trees

The main aim of the exercise is to name general deciduous trees based on their leaves. Through the work they connect the tree leaves with a right description to finish the interactive identifying key.

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Volume 50, 2012

Exercise 5 – Is it True That Moss Grows Only on the Northern Side of a Tree?

Students are measuring physical attributes to figure out if hypothesis that moss grows only on the north side is true. In the exercise they use a virtual thermometer and Lux meter and on the basis of the results test the optimal conditions for the growth of moss. The main window of exercise is presented in Figure 2.

Figure 2: The basic view of exercise 5 – Is it True that Moss Grows Only on the Northern Side of a tree?

Exercise 6 – Coniferous Trees

In these exercises work of students is completely opposite as in the exercise 4. The main aim here is to build the interactive identifying key from the descriptions of main coniferous trees from the island. Students are changing pairs of tree characteristics until they describe a particular tree. In the second part they have to connect the picture of cones with the right tree.

Exercise 7 – Measuring pH-values of the Soil under the Trees

The exercise simulates the work of measuring pH of solutions in chemistry lab. In the first part of exercise, students have to figure out the right order of work to get the feeling what is the procedure of science research in the laboratories. In the next part they compare the colours of pH indicators from two different samples to read the value of pH from the table. Again the exercise was developed in order to simulate the real work as much as possible.

Exercise 8 – Animal Adaptations

The background idea during the development of the last exercise was edutainment. In the exercise students play the role of a predator (bird), which is on the search for pray. Students have available 60 seconds to find all eatable animals and to avoid poisonous ones. During the play, they also discover how some animals mimic others; camouflage the patterns from nature or apply other tactics to survive. At the end of the game statistic of hunt is calculated automatically to present the success of particular strategies.

Classification of Exercises

According to the previously presented descriptions, exercises were ordered in Figure 3. The exercises were ordered by their ability to convince students to explore or expose a particular theme. On one hand, they simulated the real work where they have a lot of freedom (Ex 2) and on the other they were only reading the signs or inputting predicted results (Ex 1). On the other side, the axis was ordered according to the level of playfulness of the exercise. In the first case the work was done through a game (Ex 8) and in the other case the work was more similar to dull drill developed as a quiz (Ex 7).

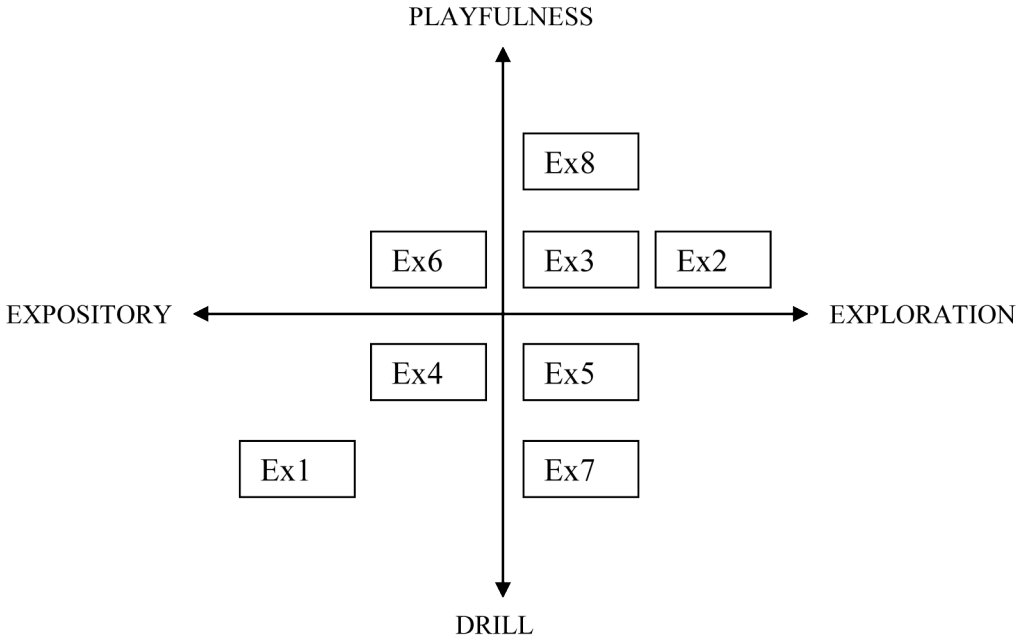

Figure 3: Selection of exercises according to their level of playfulness, drill and the level of exploration, expository.

Methodology of Research

General Background of Research

The study was conducted in May and June 2011, during the comparison of real and virtual field trip on Walk on Maribor Island trail (Puhek, Perše, & Šorgo, 2012). Students were divided in two groups: a) some worked on the exercises on the real field trip and b) other worked on the virtual field trip.

Sample of Research

In this study, only students from virtual field trip (N=133) were analysed from total 211 8th grade lower secondary school students, aged 13 and 14. The research sample consisted of 57 (42.9 %) male and 76 (57.1 %) female students. Students came from 7 different lower secondary schools near Maribor Island. The students were also classified according to their biology grades in the previous school year (2009/2010). The students participating in the study

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Volume 50, 2012

obtained the following grades in biology: 5 (3.8 %) had obtained the grade "satisfactory" (2), 22 (16.5 %) had obtained the grade "good" (3), 39 (29.3 %) had obtained the grade "very good" (4), and 56 (42.1 %) of the students included in the study had obtained the grade "excellent" (5).

Instrument and Statistical Analysis

Because of non-normal distribution of the data (Kolmogorov-Smirnov Test), the statistical analyses were conducted using nonparametric tests (Erceg-Hurn & Mirosevich, 2008). The questionnaire was structured as five-point Likert scale, where students had to fill the blank fields. Scales were valued with given numbers: 1 – not sufficient, 2 – satisfactory, 3 – good, 4 – very good and 5 – excellent. The reliability of the questionnaire was satisfied with Cronbach's Alpha that was measured 0.885 (Nunnally, 1978). The analysis of exercises measured with Likert scales are presented as percentages (%), mean (M) and standard deviation (SD). The linear regression was performed to define the variables, which had a statistically significant impact on the level of interest of exercises. The magnitude of impact of difficultness and level of interest for particular exercise was assessed using the Kruskal Wallis Test. Results are presented as p and MR (mean rank) values. In addition, the effect size was calculated with the Jonckheere-Terpstra Test (Field, 2009). The effect size (r) value of 0.1 was considered a small effect, the value of 0.3 was considered a medium effect, while the value of 0.5 was considered a large effect (Field, 2009). The analyses were conducted using the statistical package IBM SPSS Statistics 19.0.

Results of Research

Difficultness, Level of Interest and Level of Proficiency

The first part of the research covered the questions about overall difficultness (Table 2) of particular exercises, its popularity (Table 3) and its level of proficiency (Table 4). Results are presented as mean and standard deviation.

Table 2. Descriptive statistics for the difficultness of particular exercises ordered by mean.

	Ex 2	Ex 8	Ex 7	Ex 5	Ex 6	Ex 1	Ex 4	Ex 3
M	3.22	3.20	3.06	3.05	2.98	2.94	2.85	2.73
SD	1.13	1.08	1.19	1.22	1.08	1.22	1.11	1.28

Table 3. Descriptive statistics for the level of interest of particular exercises ordered by mean.

	Ex 3	Ex 8	Ex 1	Ex 2	Ex 4	Ex 6	Ex 7	Ex 5
M	3.47	3.31	3.26	3.21	3.16	3.16	3.15	3.11
SD	1.24	1.14	1.15	1.11	1.19	1.17	1.18	1.21

Table 4. Descriptive statistics for the level of proficiency of particular exercises ordered by mean.

	Ex 8	Ex 6	Ex 5	Ex 7	Ex 2	Ex 4	Ex 1	Ex 3
M	3.39	3.35	3.32	3.30	3.28	3.25	3.20	3.10
SD	1.19	1.12	1.22	1.18	1.10	1.18	1.13	1.28

Prediction of the Level of Interest

A linear regression was also performed to predict what influences the level of interest of a particular exercise. The results have shown that only the difference in schools ($\beta = 0.15$, $p < 0.01$), level of difficultness ($\beta = 0.31$, $p < 0.45$) and level of proficiency of exercises ($\beta = 0.65$, $p < 0.00$) were statistically significant. A statistically significant difference could not be identified for the students' gender ($\beta = 0.19$, n.s.), for the biology grades the students had obtained in the school year that had ended the year prior to the time period of the study ($\beta = 0.03$, n.s.), for the students' respective favourite school subjects ($\beta = 0.00$, n.s.), or for the score the students had obtained on post-test ($\beta = 0.06$, n.s.). The overall model fit was $R^2 = 0.58$.

Tendency of Virtual Field Trip Exercises

The analysis (Kruskal Wallis test) of the answers for particular exercises was made for the level of proficiency and the level of difficultness regarding the level of interest (Table 5).

Table 5. The level of proficiency and the level of difficultness regarding the level of interest for particular exercises.

Exercise	Level of proficiency					Level of difficultness				
	Grade	N	MR	p	r	Grade	N	MR	p	r
1 (The Maribor Island)	Low	19	33.92	0.00	0.37	Low	26	47.13	0.73	0.08
	Med.	41	48.12			Med.	48	50.97		
	High	40	60.81			High	26	53.00		
2 (Biodiversity)	Low	19	32.66	0.00	0.42	Low	26	42.90	0.02	0.27
	Med.	41	47.06			Med.	48	47.96		
	High	40	62.50			High	26	62.79		
3 (How old is a tree?)	Low	19	34.79	0.00	0.39	Low	26	48.15	0.24	0.13
	Med.	40	45.41			Med.	47	46.83		
	High	40	61.81			High	26	57.58		
4 (Deciduous trees)	Low	19	37.95	0.02	0.29	Low	26	52.25	0.47	0.03
	Med.	41	48.05			Med.	48	47.19		
	High	40	58.98			High	26	54.87		
5 (Illumination)	Low	18	35.92	0.00	0.37	Low	26	54.33	**0.03**	0.06
	Med.	41	45.24			Med.	47	42.82		
	High	40	61.21			High	26	58.65		
6 (Coniferous trees)	Low	19	27.97	0.00	0.54	Low	26	51.92	0.53	0.03
	Med.	41	46.13			Med.	48	47.58		
	High	40	65.68			High	26	54.46		
7 (pH-value)	Low	19	39.74	0.00	0.36	Low	26	51.37	0.52	0.05
	Med.	41	43.79			Med.	48	47.58		
	High	40	62.49			High	26	55.02		
8 (Animal adaptations)	Low	19	35.55	0.00	**0.43**	Low	26	46.94	0.71	0.08
	Med.	41	44.43			Med.	48	51.32		
	High	40	63.83			High	26	52.54		

Note: p<0.05; MR – mean rank; r – effect size (Jonckheere-Terpstra Test).

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Volume 50, 2012

The level of proficiency regarding the interest of students for exercises shows statistical significant differences for all exercises ($p<0.00$). In all cases (except exercise 4 and 6) the effect size was medium. For exercise 6 effect size was even large. Regarding the level of difficultness and the level of interest the statistical significant difference was detected only for exercise 2 and 5 ($p < 0.03$). In this case only exercise 2 pointed out the effect size of medium.

Discussion

The main aim of this study was to analyse the exercises in manner of getting the confirmation of good development or the signal for changes before performing further researches. From the teachers' point of view, the effective virtual tools are mainly those, which transfer knowledge to students with less energy. From the students' point of view the successful exercises are those, which teach them through active and fun way (Stemler 1997). One of the most important things for users to start using particular application is its attraction. In last years, developers of educational tools paid attention on the edutainment (Virvou, Manos, Katsionis, & Tourtoglou, 2002). The main idea of edutainment is to implement traditionally dull syllabus of education with a more vivid and fun fashion (Cai et al., 2003). In the Walk on Maribor Island trail the general level of interest were over the average, where particular exercises stood out. The most interesting exercises for students were those, which were based on visualization (exercise 3 – dendrology) or part edutainment (exercise 8 – animal adaptations, exercise 2 – biodiversity). Austin (2009) indicates that both individual cognitive abilities and display elements could contribute to the effectiveness of virtual learning. As suspected, the high correlations were assigned between the level of difficultness and the level of success on the post-test. Not suspected results were assigned for exercise 3, which students marked as the easiest, but in the post-test they reached barely over the sufficient grade. This may indicate that the exercise from post-test was measuring different parameter or that exercise was looking easier for students, than it was in reality. Students also classified exercises based on their difficultness and its proficiency. The exercises were developed in the manner to present biology to students in a different way – on the examples from nature. The clearest example is exercise 8, which was marked as most proficient and one of the most challenging. In this exercise, students were observing animal (prays') adaptations through the side of predator (bird). The high level of difficultness in the exercise 6 and 7 could be connected with the lack of knowledge, because not all students have worked on this thematic before. Meisalo et al. (2004) showed for high school students that the difference between the expected and observed level of difficulty of the exercises could decrease the interest for work and even make students to drop out of classes.

A linear regression as the main predictors on the level of interest pointed out the difference in schools, the level of difficultness and the level of proficiency of exercises. The difference in school could be again connected with the teacher or even with the teaching style on that school (Puhek et al., 2012). As it was said before, at the time of testing, not all students learned the same themes and not all students were equally used of virtual tools. Surprisingly there were no significant differences in the variable of students' gender or the students' biology grades. Researchers usually report male students as more technical types as female students or to have different working manners (Cooper, 2006; Kubiatko, Usak, Yilmaz, & Tasar, 2010; Lippincott, Matulich, & Squires, 2006), what was also presented in the case of testing the difference in knowledge gain from real and virtual field trip (Puhek et al., 2012). It was expected that students' grades will play an important role also (Lippincott et al., 2006; Puhek et al., 2012).

Finally, the analysis of particular exercises was made over the level of difficultness and the level of proficiency of exercises. Regarding the level of interest the tendency of answer showed that students, which marked the exercises as low proficient also did not found exercises as interesting as colleagues that marked the same exercises as high proficient. With other words,

the exercises, where particular students felt there is no new information for them, were marked as less interesting. For majority exercises the effect size was medium ($r < 0.3$), but for exercise 6 it was large ($r = 0.54$). Probably the reason is in the newness of the theme of identifying plants with dichotomous key for some students as they stated during the testing. On the other hand, the level of difficultness was statistically significant regarding the level of interest only for exercises 2 and 5. Additionally, effect size for exercise 2 was close to medium ($r = 0.27$), but for the exercise 5 it was low ($r = 0.03$). Mean rank for exercise suggested that this exercise was too difficult for some students, what affects the fall of interest for this exercise. As it was shown by Stafford et al. (2010) that digital resources could increase understanding of complex concepts in students, biodiversity was too abstract topic for majority of them, especially in the eighth grade of lower secondary school.

Conclusions

In this study the emphasis was on the analysis of the eighth exercises of virtual field trip Maribor Island. Exercises were tested regarding the level of difficultness, level of interest and level of proficiency, where the main aim was to present the tendency in biology virtual field trips that should be taken in consideration before development of new exercises.

Despite the not so considerable amount of analysed exercises the study showed directions for further development. As predicted, it was shown that students do not prefer all exercises equally. The most important role in the level of interest for the exercises played the school, students' came from, the level of proficiency and the level of difficultness. From the results it could be stated that students would rather work on playful exercise than on the exercise that is based on dull drill. They would also rather stand in the shoe of an explorer than to just expose themselves to the shopping window of new knowledge. Stated differently, students need the new learning materials that give them fresh information in a way that will assure the interest of the modern digital generation of students, which can present a challenge for teachers to achieve.

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