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STUDENTS' PERCEPTIONS OF REAL AND VIRTUAL FIELD WORK IN BIOLOGY

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Abstract

The outdoor education is a method of learning with the exposure to (not exclusively) the natural environment that combines all human senses. Students tend to acknowledge a very positive effect of this kind of learning. It is easier and more memorable to connect the theory with practice, when they see things in nature, rather than to just hear about them in the classroom. Despite its popularity, teachers face various obstacles when they take their students outdoors. Although the outdoor education is included in the Slovenian primary and lower secondary school curriculum, the percentage is not high enough, which depends on various reasons. Teachers defined lack of time, suitability of area around the school, not enough instruments for field work and to expanded curriculum as the main reasons for not including field work in the classes. Some of these obstacles could be solved by implementation of information and communication technology (ICT) into the biology and ecology classes.
In this research the results of 192 students' point of view on the importance of field work, obstacles of that kind of work and the ICT as a solution to support or replace the real field works are presented. All questioned students were prospective teachers, so sooner or later majority of them will face issues connected to the field work and possibilities to solve them with the help of ICT.
Key words: *biology education, field work, ICT, obstacles, virtual field trips.*

Introduction

Biology teaching is usually connected with one of three different learning environments; the classroom, the laboratory and the "outdoors" (Spicer & Stratford, 2001). Every learning environment has its own characteristics what makes them more or less appropriate in different teaching and learning situations (Barker et al., 2002). Common to all learning environments is that successful biology teaching should inspire problem thinking, creativity, and knowledge at the higher cognitive levels through inquiry and hands-on activities (Prince, 2004). In common teaching practice lack of active methods usually results in fall of interest and motivation, where knowledge is achieved at the lower cognitive levels (Michael, 2001; Tranter, 2004; Michael 2006; Costa & Magalhaes, 2009; DiCarlo, 2009), what should not be the intention of good teaching. The benefits of direct instructions are that they allow transfer of larger quantity of information and that the conditions in a classroom are usually more controlled than in a laboratory and outdoors. However, working in a classroom is usually not as attractive as in the second two cases (Spicer & Stratford, 2001; Špernjak & Šorgo, 2009).

Priest (1986) defined outdoor education as an experiential method of learning with the use of all senses, which primarily (but not exclusively) takes place in the natural environment. If performed in inquiry and problem based manner, students learn and at the same time develop

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skills to investigate. Inclusion of the field work enables the students to develop consciousness of processes and concepts in nature. There are two general approaches: a) the theory that is learned in classrooms or laboratory is verified in nature, and b) students first observe processes in nature and "name" them later in the classroom.

In Slovenia the outdoor education is an established method of school work for different subjects. Students are regularly visiting historical places, zoological and botanical gardens, museums or performing sport activities outside their schools at all school levels. In Science curriculum quantity of hands-on activities in elementary and lower secondary schools decrease with the grade and is in general schools mostly connected with the Physics, Chemistry, Biology and Geography teaching. From the researches (Slekovec, 2006; Vilhar & Vičar, 2007) it can be concluded that teachers do not use outdoor education frequently. Slekovec (2006) pointed out as obstacles lack of time, suitability of area around the school, expanse of department, not enough instruments for field work and too expanded curriculum as reasons for not including field work into classes. Another problem of outdoor education in Slovenia is the lack of field hours prescribed in curriculum. On the other hand, Slovenian students in most cases wish that greater part of science teaching should be performed as laboratory and field work (Šorgo & Špernjak, 2007; Vilhar & Vičar, 2007).

With the development of ICT (Information and Communication Technologies) many new possibilities were opened. For example, teachers in virtual worlds do not have any limits to take their students to explore and experience different places ranging from factual to fantasy and can be set in the past, present or future (Pan et al., 2004). In virtual world everything is possible: history students can learn about ancient Greece by walking its streets, visiting its buildings, and interacting with its people (Pan et al., 2004) or visiting a virtual museum (Styliani at al., 2009); biology students can learn about animal behaviour through virtual adventures (Boyle et al., 1996); nursing students can be prepared for medical-surgical nursing on Alzheimer's disease (Bonnel et al., 2007) etc. Although working with simulations or in virtual laboratory does not replace the laboratory or field exercises, simulations allow supplemental experiments to be performed quickly, requiring less equipment and student supervision than traditional experiments (Tignor et al. 2007; Crouch et al., 2008). Such virtual visits demands minor school time investment (Bonnel et al., 2007) and are not connected with high additional expenses, if school is already equipped with ICT or multimedia classroom with high-speed internet connections, as is the case in most Slovenian schools (Empirica, 2006). Additionally insufficient number of laboratory instruments (e. g. data loggers, microscopes, insect nets), work with hazardous chemicals or living materials are not problems anymore (Ramasundaram et al., 2005; Kaibel et al., 2006; Evans et al., 2006; Bergin et al., 2007).

Concerning field work teaching, Slovenian teachers have to fulfil objectives and aims prescribed in curricula, which are regulated by governmental bodies, but are free in choosing a method or strategy in a classroom. Besides material limitations (number of computers, lack of funds, etc.) as serious obstacle attitudes and opinions of the teachers, both toward laboratory work and usage of ICT should be recognized (Šorgo et. al, 2007, 2010; Šorgo & Kocijančič, 2011). Their attitudes toward laboratory and field work and ICT usage are formed as a result of their experiences during their study as a student, prospective teacher and professional practice. As teacher educators we were interested in their opinions about the field work. The reason was to help them to bridge detected obstacles during their university courses, both in virtual and real field work, to increase quantity of such work in their future teaching practice. Questioned students (N=192) were attending four different educational programmes, so they could be also taken as the prospective teachers. The question which obstacles and responsibilities are marked as important and if their answers differentiated regarding their study programme concerning the role of student and the role of prospective teacher was answered.

Outdoor Education in Curriculum for Slovenian Primary and Secondary School

The Slovenian curriculum for general upper-secondary schools (called "Gimnazija") prescribes that biology teachers have to perform field work in minimal 7 % of all hours selected for compulsory program in general (Vilhar, 2008a) and vocational upper-secondary school (Vilhar, 2008b). In the program of general "Gimnazija" (students finish with Matura exam) the amount of hours that has to be performed is minimal 14 hours of total 210 hours. This means that teacher is obliged to perform only 5 hours of field work teaching per year. A quite similar prescription can be found in the case of geography in general (Polšak, 2008) and vocational upper-secondary schools (Lipovšek, 2008). Students have to attend one whole day excursion per school year. However, additional field trips are recommended and the amount of them depends on the teacher. In the curriculums for the primary schools the outdoor activities are compulsory and are usually performed through the one-day excursions.

Participants

The research was performed on 192 students of the Faculty of Education and Faculty of Natural Sciences and Mathematics, University of Maribor. All students were included in the educational programmes, so they can be considered prospective teachers. The researching sample consists of four different study programmes: Primary teacher education (N=80, 41.7 %); Primary teacher education – emphasis on biology (N=27, 14.1 %); Preschool education (N=42; 21.9 %); and Biology education (N=42, 21.9 %). The study programme Primary teacher education was additionally separated, because particular students choose an additional biological subject, where they investigated nature and natural phenomena. All students were attending Biology (69; 36 %) or Natural science classes (123; 64 %), where they spend at least few hours in the nature to connect the theory from the classrooms and laboratories with the practical activities. The sample consists of 105 (54.7 %) 1st year, 49 (25.5 %) 3th year and 38 (19.8 %) 4th year students. As the most experienced with biology could be considered biology students and students of the study programme Primary teacher education, which have chosen additional biology subject. Students were also classified by their favourite subjects. 104 (54.2 %) students have chosen social sciences and 72 (37.5 %) have chosen the natural sciences students – 16 (8.3 %) students could not decide for a particular subject. Sample was not selected randomly. The selected students were chosen, because they can all be acknowledged as potential future teachers which will use the method of field trip.

Instrument and Statistical Methods

The questionnaire was anonymous. It was structured as five-point Likert scale, where students had to fill the blank fields. Scales were valued with given numbers: 1 – highly disagree, 2 – disagree, 3 – without opinion, 4 – agree and 5 – highly agree. To get more details about some questions the students were given the opportunity to additionally explain the answer. Additional explanations of answers were later grouped by meaning, where most frequent answers were pointed out.

Results of answers measured with Likert scales are presented as percentages (%), mean (M) and standard deviation (SD). Results gained with additional explanations are written as the most common meanings/answers. The linear regression was performed to define the obstacles that students reported as significant. Additionally, the nonparametric test (Kruskal Wallis) between groups of students was performed. Results are presented as p and MR (mean rank) values. The analyses were performed with statistical package IBM SPSS Statistics 19.

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Results of Research

Importance of the Field Trip

The first part of the research covered the themes about the importance of field work for the students. Judging from the obtained results, students take field work as an important way of learning (M=4.34; SD=0.73) – 42.7 % highly agreed and 47.3 % agreed. Most common explanations for their answers were: "*It is easier to remember, if you see things in nature*"; "*The outdoors is more interesting, if compared to boring classrooms*"; "*In the outdoor I can connect the theory with practices*". As expected, students would like to perform more classes outdoors (M=4.12; SD=0.67) – 25.0 % highly agreed and 64.6 % agreed. They also rather attend shorter field trips (M=3.55; SD=1.05) in comparisons to the daily trips – 13.0 % highly agreed and 53.1 % agreed.

The Kruskal Wallis test additionally showed that students do not agree equally. Answers, separated by students' study programme, statistically significant distinguish the importance of the field works ($p<0.01$). Students of the study programme Preschool education (MR=77.42) and Primary teacher education (MR=87.25) did not see field trips as important as their colleagues form Biology education (MR=102.74) and Primary teacher education – emphasis on biology (MR=115.67). Answers did not significantly distinguish for the quantity ($p>0.07$) and length ($p>0.57$) of the field trips.

Obstacles and Risks Concerning Field Work

In the second part of the research the students were questioned about the potential obstacles and risks concerning the work in the outdoors. The obtained results suggest that students do not want to avoid field work (26.2 % highly agreed and 54.2 % agreed), but they are familiar with the notion that many responsibilities are connected with that kind of work (38.3 % highly agreed and 51.4 agreed). Obstacles are separately presented in Table 1. The linear regression analysis on given obstacles (Table 2) was performed, where significant differences appeared only for categories financial costs ($p<0.00$), to many preparation ($p<0.00$) and teachers' responsibility ($p<0.02$).

Table 1. Frequencies (%) of importance (ordered by mean) for different obstacles that are connected with outdoor teaching.

Obstacle	1	2	3	4	5	M	SD
Teachers' responsibility	0.5	5.7	27.1	**47.4**	19.3	3.79	0.84
Law and orders	1.6	14.1	32.8	**44.3**	7.3	3.42	0.88
Financial costs	3.1	15.1	26.6	**46.9**	8.3	3.42	0.95
Not enough class hours in curriculum	2.1	13.5	**37.5**	36.5	10.4	3.40	0.92
Not enough instructions in curriculum	1.6	11.5	**40.1**	39.1	7.3	3.39	0.85
Inappropriate school surrounding	2.6	20.3	**37.0**	35.4	4.7	3.19	0.90
To many preparation	3.1	29.7	**32.8**	30.2	4.2	3.03	0.95
Waste of time	7.8	**37.5**	23.4	25.5	5.7	2.84	1.07

Note: N = 192 students; 0 – no answer, 1 – highly disagree, 2 – disagree, 3 – cannot decide, 4 – agree, 5 – highly agree; M=mean, SD=standard deviation.

Table 2. Linear regression analysis for obstacles given by prospective teachers that play crucial role on the responsibilities on field trips.

Obstacle	B	Std. Error	p
Financial costs	0.18	0.06	**0.00**
Waste of time	0.01	0.05	0.88
Law and orders	0.05	0.06	0.41
Not enough class hours in curriculum	0.03	0.06	0.66
To many preparation	- 0.19	0.06	**0.00**
Inappropriate school surrounding	- 0.00	0.06	0.97
Not enough instructions in curriculum	0.03	0.07	0.67
Teachers' responsibility	0.17	0.07	**0.02**

Note: N = 192 students, p<0.05.

The analysis (Kruskal Wallis test) of the answers separated by students' study programme showed statistically significant differences for categories financial costs (p<0.00) and responsibilities of the teachers (p<0.01). In both cases biology students stood out (Table 3). Students agreed on the category to many preparation (p>0.24).

Table 3. Kruskal Wallis results test for given obstacles, separated by students study programme.

Study programme	Financial costs		To many preparations		Teachers' responsibility	
	N	MR	N	MR	N	MR
Primary teacher education	80	85.18	80	89.12	80	101.00
Primary teacher education – emphasis on biology	27	89.46	27	90.78	27	85.93
Preschool education	43	94.56	43	103.70	43	78.26
Biology education	42	**124.58**	42	106.87	42	**113.40**

Note: MR = mean rank.

Information Communication Technology and Field Work

Finally, the students' opinions of ICT as a helping tool or even as a substitution for real field work were collected. Generally, students declared that ICT has a huge potential as a helping tool for preparations on the field work (70.3 % agreed and 8.9 % highly agreed; M=3.82; SD=0.73), but it cannot under any circumstances represent a substitution for field work (37.5 % agreed and 19.8 % highly agreed; M=3.64; SD=0.97). Most common explanations for why ICT is an appropriate helping tool were: "*You can avoid bad weather or other risky situations*"; "*There is a potential to observe endangered organisms without making another pressure on them*"; "*In virtuality we are able to visit unreachable places*". On the other hand, the two most typical answers from students that are not inclined to ICT were: "*Nature cannot be substituted with anything*" and "*There are already too many computers in our lives*". Results were also separated by students' study programme (Table 4).

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Table 4. The Kruskal Wallis test results for given suggestions, separated by students' study programme.

Study programme	ICT as helping tool		ICT as substitution	
	N	MR	N	MR
Primary teacher education	80	**108.48**	80	97.55
Primary teacher education – emphasis on biology	27	93.63	27	98.69
Preschool education	42	**71.55**	43	**76.99**
Biology education	41	95.95	42	**113.07**

Note: MR = mean rank.

The results significantly distinguished for both suggestions: ICT as a helping tool ($p<0.00$) and ICT as a total substitution for field trip ($p<0.02$). Students of programmes Preschool education were less willing to use ICT as a helping tool, but were surprisingly the most interested to use it as substitution. As suspected, students of the study programme Biology education were against the substitution of the field work with ICT.

Discussion

Traditionally biology teaching takes place in the classrooms, in communities, and in other places like nature centres, museums, parks, zoos etc (Carleton-Hug & Hug, 2009). As shown from the results, students prefer last of them – the outdoors. They would like to take more class hours in the nature, instead of (as they declared) "boring" theory. Our results confirmed the analyses of curriculum for Biology (Vilhar & Vičar, 2007, p.46), where they declared that students would like to have more experimental hours and field work activities. With this kind of work they have less difficulties understanding the processes in biology, knowledge is more permanent and the students can easier get in touch with the work of a biologist. The impact of the outdoors on the students as the instructor, the motivator and the connector could be classified based on gained feedback and similar researches. In the outdoors the students can apply knowledge and skills to develop an appropriate solution for a specific problem, where theory is integrated into practice (Savery, 2006). At the same time, outdoor activities help to motivate students; they inspire them and enable a different approach of learning for students, who may otherwise be side-lined by a more formal classroom situation (Barker, 2002; Dahlgren & Szczepanski, 1998). The problem based learning also gains in importance in the field of science education, because it combines theory and practice, and it also enables the development of higher order thinking skills (Savery, 2006; Simmons, 2008). Despite all advantages of learning in laboratory or in the field, teachers are prepared to sacrifice that kind of work for more "economical" ways of teaching (Šorgo & Špernjak, 2007; Šorgo & Kocijančič, 2011). Results also showed that biology students are major supporters of the field work. On the other hand, as concerning could be acknowledged the fact that the students of the programme Preschool education are less favourable to this kind of teaching, since this could deviate youngsters even further away from the nature.

Since our sample included students from educational study programmes (prospective teachers), the obstacles and responsibilities that are concerned with teaching in the outdoors were also a point of interest. Results also suggested that students are aware of the responsibilities and potential obstacles that they are going to face when they are going to start teaching, but their answers are different as those given by the teachers. As expected, the most often stated obstacle was the responsibility of teachers and the assumption that the outdoor teaching is a big

consumer of time. Concerning Slovenian teachers, different priorities of obstacles were given by Slekovec (2006). For the reasons of avoiding the outdoor activities, she basically pointed out the bottom lines of the Table 1 (unsuitable area around the school, lack of time, expanded curriculum, etc.). From this it can be concluded that students are not familiar with the curricula or with the preparation of the class hours and have lack in teaching experience. Another interesting suggestion obtained from the answers was that students cannot decide whether the outdoor activities should be carried out by special organizations instead of teachers. Probably because of the experiences with field work they faced during their study, biology students' answers were statistically significant different from their colleagues from the other study programmes. They considered financial costs and teachers responsibilities significantly more important as others.

While the curriculum needs time to be changed, the "evolution" of information and communication technologies (ICT) is much faster. With the development of ICT, the traditional methods of teaching, in which teacher plays the central role, are being transformed into new technology-assisted methods (Morgil et al., 2004), where the ICT can be defined as a helping tool for the traditional teacher. Similar changes are possible in outdoor education as well, especially with the knowledge that all Slovenian schools are well equipped with computers for teaching and have internet access (Empirica, 2006). When students were asked about ICT as helping tool for field work, similar results as Bonnel et al. (2007) and Spicer and Stratford (2001) were gained. Students do like virtual field work and gain useful information for practice through them but generally found them useful mainly for preparation or revising after or before a real field trip. They pointed out the importance of ICT as a tool where nothing is too far away to see and can be used as a possibility of avoiding risks. The possibility to use ICT as tool to protect nature was also indicated. Additionally, as it was suggested by Puhek and Đorgo (2010), students acknowledge the importance of virtual tools in mother language since this way youngsters avoid difficulties with understanding the learning material. Only 5 students (2.6 %) highly disagreed and 33 (17.2 %) disagreed regarding the importance of learning with tools in mother language. Finally, as mentioned by Ruchter et al. (2009), ICT technology motivates the students for work which can bring science closer to the youngsters (Underwood et al., 2008). But despite all positive sides, students would not like to change the real field trips for virtual ones, because nothing can be compared to the real experience in nature. Students' opinions differentiated regarding pros and contras of ICT as helping tool or substitution for the field work. Again, the biology students played the role of protectors of the field work and, on the other hand, students of the programme Preschool education were the most interested to use ICT as substitution for it. The most appropriate explanation for gained results would be that biology students attend much more field trips during their study in comparison with the students of other programmes.

Conclusion

A learning method that does not contain only writing and learning masses of theory is in students' eyes considered modern and positive. This enables the students to avoid the routine that is often present in regular classes. When students are more relaxed they are more opened to absorb knowledge. This could also lead to the highest level of cooperation between students and the teacher. It is not our intention to present the outdoor education as a primary teaching method, because the optimal teaching principle is a combination of different teaching methods. When learning theory the optimal place is inside a schoolroom, however, when observing natural processes there is no better place than the nature itself.

Results gained in this research showed that in general students favour the outdoor activities and would like to attend more classes in the nature. Learning outside the classroom is more attractive and helps students to easily connect the theory and practice. On the other hand,

as prospective teachers, they are aware of different obstacles and risks that are connected with teaching outdoors. One of the solutions to bridge the obstacles is the usage of ICT that could be applied with minimal changes and investments. Students see ICT as useful supporting tool to the field work, but they would not change the experience in nature for computer work. The research also showed that students from different study programmes have a different attitude towards the field work. To the opposite of the biology students, which support the real field work, the students of the Preschool education programme tend to favour ICT as substitution for field work.

The aim for the future is to gain teachers' opinion about the (virtual) field work and to develop a new virtual environment based on that knowledge. This should be created in a way that combines the majority of positive sides of the field work and includes suggestions of potential users (students and teachers). Despite the fact that the virtual environment is usually static and does not train hand skills, the activity of students would be preserved anyway. There is no doubt that it is better to observe and work in the "real" natural environment, but ICT can serve as optimal replacement in cases when this is not possible or just provide an environment for preparation and practice. For conclusion, a virtual field trip could be compared to a movie, filmed after a book (presented as real field work). Everybody suggest that reading a book is better, but watching the movie cannot be avoided anyway.

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