Web-Site as an Educational Tool in Biology Education: A Case of Nutrition Issue

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Abstract

The purpose of the study was to evaluate the efficacy and feasibility of using website in biology education. We have explored the World Wide Web as a possible tool for education about health and nutrition. The websites were teaching tools for primary school students. Control groups used the traditional educational materials as books or worksheets, and the experimental groups used prepared web-site as an educational tool. This experimental study confirmed the efficacy of computer–based nutrition education in nutrition knowledge. Nutrition knowledge score of the experimental group was statistically non-significant as compared to control group both in posttest and retention test, which means that using website in nutrition education has similar effect on nutrition knowledge as traditional teaching. Thus, traditional teaching is still valuable compared to ICT approach in nutrition education.

Key Words

ICT, Nutrition Education, Website.

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Information and communication technology has been used in a variety of ways at all types of schools. Especially, ICT's has been used in education, organization of education, in the methods and forms of education and they are also integrated at management of schools. Considering that ICT's are commonly used in everyday lives of young peoples, the use of ICT in schools is more and more common (Bahar, Aydın, & Karakırık, 2009; Başer & Durmuş, 2010; Bingimlas, 2009; Erdogan, 2009; Juuti, Lavonen, Maija, & Meisalo, 2009; Kreisel, 2004; Ogilvie, Trusk, & Blue, 1999; Sorgo & Kocijančič, 2006; Sorgo, Verčkovnik, & Kocijančič, 2010).

Studies have also shown that computer anxiety, lack of confidence influence acceptance of computers and their use as well as the knowledge. Positive attitudes of teachers towards ICT are important for implementation and necessary for effective using of ICT in educational process (Camnalbur & Erdogan, 2008; Kubiatko & Haláková, 2009; Sorgo et al., 2010; Spernjak & Sorgo, 2009).

According to Markauskaite (2006), using computers was primarily associated with programming and logical scientific thinking. Therefore, computers and ICT have been primarily viewed as a male domain (Brosman, 1998), especially in mathematics and technological disciplines. The number of researcher proved that boys are more interested in computers than girls and have more positive attitudes about computers and ICT. Brosman, (1998) and Sharpe (2004) found out that both boys and girls perceived ICT as males' domain and men were more outperformed in ICT skills. To the contrary, girls were less confident in using and about their ICT competencies (Fančovičová & Prokop, 2008; Graff, 2003). Interestingly, however, attitudes towards ICT among young people are generally positive (Kreisel, 2004; Ogilvie et al., 1999; Paris, 2004).

Differences in attitudes toward ICT between boys and girls have not been only found at primary schools children, but also between students and teachers (Rosen & Weil, 1995). Teacher attitudes towards computer are very important factor related to the teacher´s role towards effective use of computers in education (Palaigeorgiou, Siozos, Konstantakis, & Tsoukalas, 2005).

Teaching biology is often faced with practical problems like keeping animals at schools, ethical concerns about animal dissections, etc. (e.g. Millett & Lock, 1992), thus the use of ICT in biology settings is hotly

debated. Romi, Hansenson, Hansenson, & Gan (2002), for example, found that using computers in biology education resulted in more positive attitudes toward biology of participants. Many authors (e.g Kiboss, Ndirangu & Wekesa, 2004; Sorgo et al., 2010) point to using computer´s program at education can be effective by increasing knowledge (Sorgo, Hajdinjak, & Briski, 2008), achievement in biology and attitudes towards biology as well.

Acquisition of knowledge in the area of health and nutrition, positive attitudes towards nutrition and healthy eating habits are very important for the health of everybody. Pupils aged 13-years are becoming to be independent and autonomous and they are starting to buy foods independently from parents. That´s just it they need good knowledge and skills for selecting from variety of nutritive items which are more attractive than their nutrition value. With respect to low popularity of the nutrition themes, it is necessary to use a tool which could be interesting, funny for pupils and could attract pupil´s attention. Just then computers and web-sites are the communication medium with text, sound, colored pictures, animations, could be valuable tool in education, at biology lessons. The medium is very important for interventions relating to nutrition and right eating habits. Research confirms that nutrition interventions are effective in improving eating habits of participants (Kreisel, 2004).

Brug, Campbell, & Van Assema (1999), Oenema, Brug, & Tan (2005), Brug, Oenema, Kroeze, & Raat (2005), Çepni, Taş, & Köse (2006); and also Cepni (2009) confirmed that computer´s supported – modification education was more effective than traditional education. Kroeze, Werkman, & Brug (2006) evaluated effectiveness of nutrition interventions and they stated that many nutrition´s studies (for reduction fat and rice consuming fruit and vegetables) achieved positive results.

Most of cited studies (Brug, Campbell et al., 1999, Brug, Oenema et al., 2005; Oenema et al., 2005) dealing with interventions by the medium of computers conclude that computer´s interventions are the medium for supporting of healthy eating habits and for increasing physical activity. Meta analysis of nutrition researches found out that 20 of 26 interventions achieved significant and positive effect (Oenema et al., 2005). Paris (2004) students were interested in education by web-sites. The main reasons were animations, graphic, and 76% of students have wanted this type of education (instead of traditional education). In spite of effectiveness of this kind of education (De Vries & Brug, 1999; Oen-

ema et al., 2005), it is criticizing by many investigators because lack of social contacts (Brug, Oenema et al., 2005).

In contrast to previous studies, data about effectiveness of web sites in nutrition education programs among primary school pupils are lacking (Kreisel, 2004). Moreover, no study examined the use of web sites without direct teacher control, but rather combinations of traditional and web-based programs were used (Kreisel, 2004). In the present study, we had explored the world – wide web as a possible tool for education about health and nutrition. The websites made on CD-ROM were teaching tools for pupils of primary schools. Our main research questions were:

• Are there any differences between ICT base approach and traditional approach in nutrition education?

• Are there any gender differences in nutrition education outcomes?

Method

We created two groups - control and experimental – intervention groups. Control groups used traditional educational materials as books, worksheets and experimental groups used prepared web-site as an educational tool. The materials and the web-site contented nutrition information and were aimed at health and eating habits oh primary pupils. The web site was created in Slovakian language and was temporary freely available during the time when experiment was conducted. The content of the web site correspond with existing biology curriculum valid for all Slovakian schools. Moreover, it included additional information concerning nutrition topics and nutrition based diseases.

Knowledge about health and nutrition and also attitudes towards computers were measured at baseline (pretest), after intervention (posttest) and after 3 months (retention test). Knowledge in questionnaire was defined by the contents of web – site and with curriculum of biology. The questionnaire contented basic nutrition questions, for example contents of vitamins in fresh fruits and vegetables, importance of physical education, about healthy breakfast, about contents of calcium, protein, fiber, sugar in the food, about drinking fluid, healthy life style, cause of hepatitis, nutritional value and metabolism.

Attitudes questionnaire was completed at baseline in two groups, one month before and 1 week after intervention and after 3 month

in groups. After intervention experimental groups filled out attitudes questionnaire, the pupils evaluated web-based education, usability, contents and design of web-site (Cronbach's alpha = 0.87). The knowledge questionnaire consisted of 23 multiple - choice questions with three answer possibilities and also assorted questions about nutrition and eating habits (for seeing samples look ***Ek 1***). Reliability (Cronbach's alpha) of the knowledge questionnaire administered prior to (pretest) or after the treatment (posttest and retention test) ranged between 0.68 – 0.74. Demographic data, such as age and gender, were assessed. Attitudes toward ICT questionnaire consisted of 27 Likert-type items responded by participants from 1 (strongly disagree) to 5 (strongly agree) (for seeing samples look ***Ek 2 & 3***). Computer attitudes scale was used to collect data on the computer attitude of the girls and boys. The scale elicited information on the computer attitude and had sub-scales: computer anxiety, computer confidence, computer liking, and computer usefulness. Reliability of this questionnaire was high (Cronbach's alpha = 0.87). Further details about validity of questionnaire can be found elsewhere (Fančovičová & Prokop, 2008). The pupils were required to indicate their level of agreement or disagreement with the listed statements. Negatively worded statements were coded in reverse order. Attitudes toward ICT were assessed only in pretest to control for potentially confounding effect of different perception of ICT by participants.

Research was conducted at three randomly chosen primary schools in Slovakia. The main criterion for selecting the schools was they had enough computers per pupils. A two-week research (4 lesson of biology) was realized by three independent teachers in 6 classes. All pupils were 6th graders (mean age ± 13-years). A total of 58 pupils were in experimental groups and 80 pupils in control groups. Average number of pupils per class was 23. Approximately 2 pupils worked in one computer. Pupils used the computers in pairs. To minimize effects of teachers on children outcomes, the three teachers were chosen because all 1. graduated in the same faculty, 2. are similarly aged (~ 30 yrs) and 3. had similar practical experiences with teaching. Moreover, 4. each teacher taught participants from experimental and control groups.

The validity of all questionnaires was established through review of three experts in the field of biology education. All were asked whether the items were relevant to the goal of the questionnaires. Revisions were based on their comments and suggestions.

Statistical Analyses: To test the effect of intervention on the knowledge about health nutrition, repeat-measures multivariate analysis of covariance (MANCOVA) was used. Posttest score and score from retention test were defined as dependent variables with two repeats. To avoid effect of potentially confounding variables, pretest score from nutrition knowledge test was defined as covariate. In addition, to eliminate effects of more or less interested participants in terms of their interest to ICT, mean score from attitudes toward ICT questionnaire was defined as a second covariate. Gender (males and females) and group type (experimental and control) were categorical predictors. Children who did not participate in at least one of three tests (i.e., pretests, posttests and retention tests) were automatically excluded from final analyses.

Results

The results of independent variables on nutrition knowledge posttest scores are shown in Table 1. Nutrition knowledge pretest score influenced posttest results. In contrast, neither attitude toward ICT nor gender differences were related with posttest scores (Tab. 1, Fig. 1). Interaction between variables was generally non-significant. One exception was the interaction between nutrition knowledge posttest score and attitude toward ICT score. Detailed analysis revealed that this interaction was related mainly to nutrition knowledge measured in retention test, in which participants with more positive ICT attitudes tended to show somewhat higher score from nutrition knowledge. Overall mean score of attitudes toward ICT ranged from 1.90 (negative attitude) to 4.45 (positive attitude) (total mean score=3.43, SE=0.04). This means that attitudes to ICT were neutral/positive rather than negative.

Table 1.
Results of Repeat-Measures Mancova on the Effects of Selected Variables on Nutrition Knowledge Score (Posttest and Retention Test).

	SS	DF	MS	F	P
Nutrition knowledge (Pretest)	465.51	1.00	465.51	17.84	0.00
Attitudes to ICT (Pretest)	1.99	1.00	1.99	0.08	0.78
Gender	2.09	1.00	2.09	0.08	0.78
Group	105.22	1.00	105.22	4.03	0.05
Gender×Group	0.05	1.00	0.05	0.00	0.96
Error	2792.24	107.00	26.10		

↳

Nutrition knowledge (posttest + retention test) (hereafter PRT)	28.25	1.00	28.25	3.88	0.05
Nutrition knowledge PRT × Nutrition knowledge (Pretest)	0.79	1.00	0.79	0.11	0.74
Nutrition knowledge PRT × Attitudes to ICT	30.79	1.00	30.79	4.22	0.04
Nutrition knowledge PRT × Gender	0.07	1.00	0.07	0.01	0.92
Nutrition knowledge PRT × Group	0.72	1.00	0.72	0.10	0.75
Nutrition knowledge PRT × Gender ×Group	4.43	1.00	4.43	0.61	0.44
Error	780.11	107.00	7.29		

Detailed analysis of means revealed that scores of participants in the control group exceed mean score of participants from experimental group (Fig. 2). These differences occurred in all three types of nutrition knowledge tests. Mean scores of posttest and retention test did not differ (Tukey post-hoc test, $p = 0.42$), but pretest score significantly differed from posttest and retention test scores (paired t-tests, all p's < 0.001).

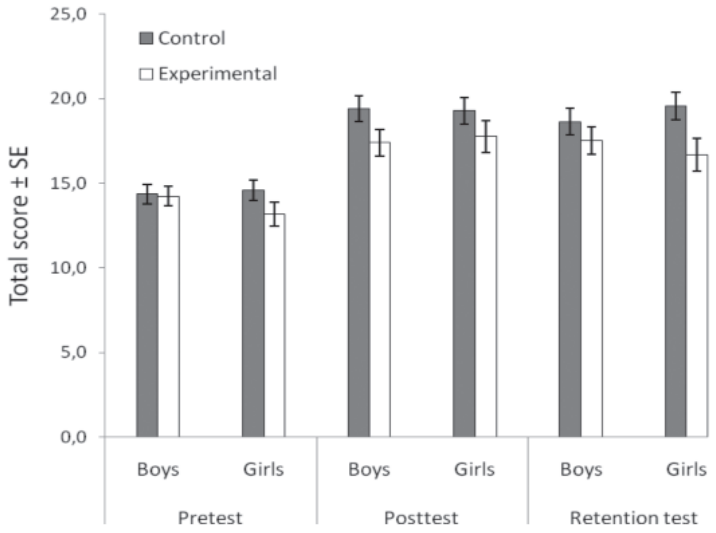

Figure 1.

Differences in Nutrition Knowledge Scores Measured in Pretest, Posttest and Retention Test in Control and Experimental Group and Between Boys and Girls.

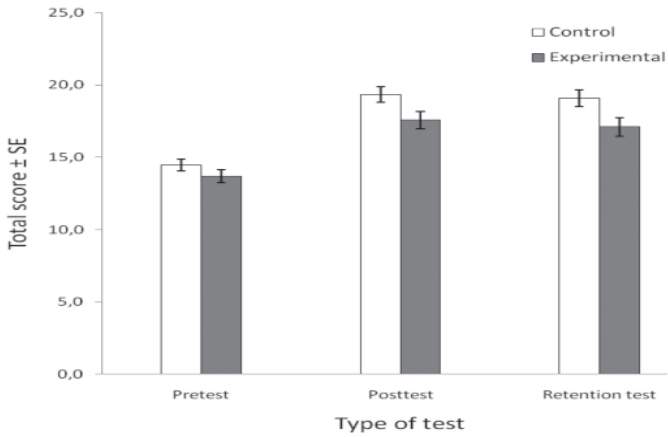

Figure 2.

Differences in Nutrition Knowledge Scores Measured in Pretest, Posttest and Retention Test in Control and Experimental Group. Minimum of Point was 0, Maximum was 29.

Descriptive Analysis of Pupils´ Knowledge about Nutrition

Pupils had good knowledge about basic questions of healthy nutrition, for example contents of vitamins in fresh fruits and vegetables (question 13, 16), about physical education (question 19), about healthy breakfast (question 4), about contents of calcium in the food (question 5), about drinking fluid (question 12). Successfulness in these questions was higher than 80%. Several other questions were correctly answered by 50 – 80 % pupils. Question 2 about two types food supported strong bones was answered identically in the all tests (pretest, posttest, and retest). On the contrary, in questions directed on contents of protein (question 6), water in the human body (question 1), healthy life style (question 18), cause of hepatitis (question 17), nutritional value and metabolism (questions 22, 21) were answered better in posttest and retest. Questions with low successfulness than 50% in pretest and more better in posttest related to questions about sugar (question 3), function and source of vitamins in the human body (questions 7, 14, 9), source of fibre (question 15) and function and source of protein and energy (questions 8, 10, 11). In few questions (3 and 14), the mean score of retention test was higher than the mean posttest scores. We suggest that participants would be more interested in these topics after receiving initial information about sugar (question 3) and vitamins (question 14) in real life, thus their mean scores continuously increased.

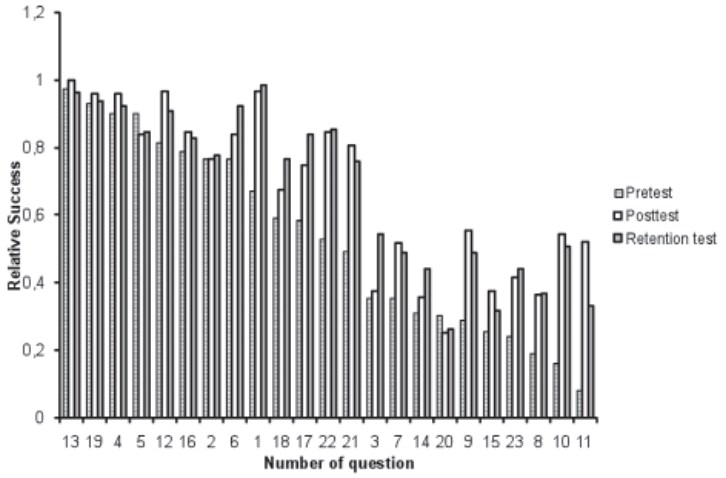

Figure 3.

Relative Success in Solving Knowledge Questions About Nutrition. The Order of Questions is Ascending from Best to Worst Answered Questions.

Discussion

The purpose of the research was to verify the World Wide Web as a possible tool for education about health and nutrition. This type of experimental design was the pilot in Slovakian primary schools. Even though, web-sites offers many interesting possibilities, there were not so many researches that would confirmative their effectiveness in experimental design.

We confirmed that using ICT in education in biology lessons increased knowledge about nutrition (as compared with pretest) but traditional approach increased nutrition knowledge slightly more. Importantly, attitudes towards the use of ICT were not responsible for these differences. Comparing these results with other studies is somewhat complicated because the same experimental design was never used. Kreisel (2004), for example, did not find any differences between knowledge of 9-11 years pupils in control (without ICT) and experimental (used ICT) groups. However, pupils in experimental groups worked with computers and also with traditional materials in her research, whereby pupils of our experimental groups worked only with computers – with web-site. In addition, our participants were older than Kreisel´s respondents. However, our study supports Kreisel's conclusion that traditional approach

is still more effective in acquiring nutrition knowledge compared with groups with ICT-only approach.

Another researcher used nutrition interventions on samples of adults, money-making people. Most of them were mostly related on the amount of reduced food after ICT interventions (e.g., Bourdeaudhuij, Stevens, Vandelanotte, & Brug, 2007; Camnalbur & Erdogan, 2008; Oenema et al., 2005). Their results are however not comparable with ours because our dependent variable was nutrition knowledge, not changes in nutrition habits.

Pupils in our research also positively evaluated graphic of web-site about nutrition. On the other hand they were more conservative in substitution of teacher by computers. We found out from opinions that pupils have liked the education through the web-site but they did not want to learn every lesson by computers. They would like to utilize ICT as a supplement of education not as only school´s method. The main reason was that the teacher is able to explain better than computer. These results are in strong agreement with Spicer and Statford (2001) and Paris (2004) who also found that the role of teachers (according to participants' responses) cannot be displaced with the ICT methods.

In Ng-Gunstone (2002) study´s students valued web-site education as it is in our study. Pupils in our study more positively scored an attraction of ICT lesson.

In contrast to other studies, we did not find differences in nutrition education knowledge scores favoring girls (Prokop, Prokop, & Tunnicliffe, 2007) or more positive attitudes toward ICT in boys (Brosman, 1998; Fančovičová & Prokop, 2008; Graff, 2003; Sharpe, 2004). We suggest that these inconsistencies would be explained by conflict between originally higher interest in human biology and less positive attitudes toward ICT in girls. It may be that the former factor positively influenced the use of ICT in females and finally resulted in overall positive effect.

This experimental study confirmed the efficacy of computer – based nutrition education in nutrition knowledge. The knowledge in experimental groups was the same as in control – traditional group. Nutrition web-sites seem to be equal teaching tools for nutrition education compared with traditional methods. The attitudes towards computers are generally positive and pupils are motivated by computers. We therefore do recommend the use of ICT in nutrition education programs as this

method resulted in similar outcomes of learners like traditional methods. Teachers might invest more time to managing ICT lessons and conversely less time to obtaining expensive books or other tools typical for traditional teaching. Further research examining whether ICT lessons in nutrition education influence children appreciation of modern technologies in other school subjects as well as its connections with everyday life is required.

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Ek 1: The Sample items from Knowledge test

1. How many percent of water is in our body?

2. The most of proteins are in: a) orange b) meat c) bread

3. The source of energy are: a) proteins b) vitamines c) fats

4.For growthing strong bones is necessary:

a) fruit b) meat, fish c) milk, cheese and yogurt

5. Which groups is rich on fibres?

a) meat groups b) fruit and vegetables c) milk groups

Ek 2: The Sample items from Attitudes towards using of ICT

1. I like using computer for communication

2. Computers horrified me

3. I would like to spend more time using computers

4. I would like to know more about cmputers

5. I am unhappy when I have to work with computers

6. Using computers I learn more and I have better knowledge

7. I am more creative with using computers

8. Using e-mail I can learn more about different cultures

Ek 3: The Sample items from Attitudes questionnaire after intervention

1. Biology lesson with website was very interesting for me

2. Learnig by website is wasting of time

3. I learn more in traditional education

4. I liked pictures in website

5. Using website I learned more

6. I would like to learn biology by using website

7. I missed concepts of topic

8. I think that my teacher can explain more and better than using website