

Lower secondary school pupils' misconceptions about photosynthesis and plant respiration: Pilot study

Katerina Svandova

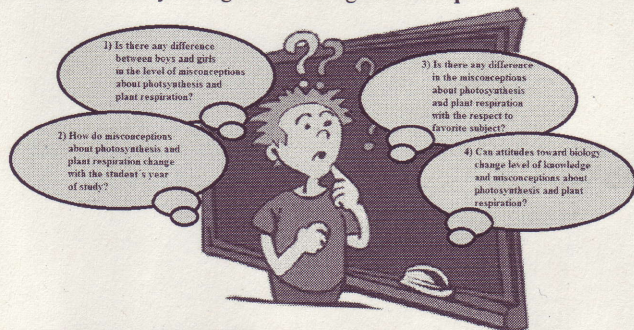


INTRODUCTION

The study investigated the common misconceptions of lower secondary school students regarding the concepts of photosynthesis and plant respiration. It is well known that students' misconceptions in science are pervasively stable and, as a general rule, are resistant to change, at least through traditional instruction (Fisher, 1985). As a result, misconceptions about natural phenomena are often held by people their whole life. To overcome misconceptions, students must become aware of the scientific concepts, the evidence that take on the validity of their misconceptions and the scientific concepts, and they must be able to generate the logical relationships between the evidence and alternative conceptions (Lawson & Thompson, 1988).

AIMS AND RESEARCH QUESTIONS

The main aim of study was to examine the level of misconceptions by lower secondary school students on the topics of plant physiology (primarily misconceptions about photosynthesis and plant respiration). The secondary aims are the influence of gender, year of study, favorite subject and attitudes toward biology versus the degree of misconceptions. We achieved this by asking the following research questions:



METHODS

The sample size included lower secondary school students from grade 6th to 9th. Girls accounted for 59.4 % of the sample size. Respondents were from the same lower secondary school located in an urban area and were divided by their favorite subject into two groups: respondents with science subject as favorite (n = 10), respondents whose favorite subject is one another than science (n = 98).

The research tool is divided into four parts. The first part includes introduction information about the research tool. The second part contains demographic variables (gender, grade and favorite subject). The third part is the test and the fourth part is the questionnaire regarding attitudes toward biology. The test part is graded as two-tier test in which the answer is collected in two steps: in the first step, students choose the correct answer of a multiple-choice questions (the knowledge part of test – it consists of 19 questions with 2–4 answers) and in the second step, students opt for the explanation of the answer (2–4 explanations). The fourth part of research tool was made up of a questionnaire with 17 items regarding to attitudes towards biology. The items were 5-point Likert type items (from strongly disagree to strongly agree).

ACKNOWLEDGEMENT

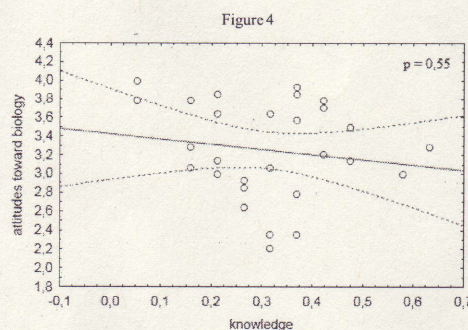
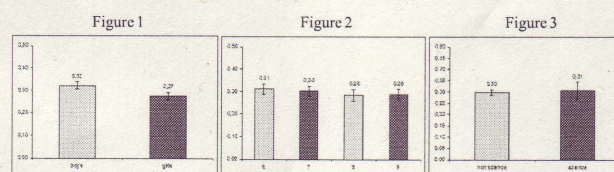
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RESULTS

The Mean score for knowledge part of the test was 0.30 (SD = 0.12) which shows a low-level knowledge about photosynthesis and plant respiration. Students' responses were analyzed with respect to gender, year of study and favorite subject. The results were gained on analysis of variance (ANOVA). They showed statistically significant difference between boys and girls ($F = 4.07$, $p < 0.05$) in favour to boys (Figure 1). As regards the other observed variables (year of study and favorite subject), there were no statistically significant differences. The values of analysis of variance for variable year of study were ($F = 0.29$, $p = 0.88$), and for favorite subject were ($F = 0.05$, $p = 0.83$) (Figures 2 and 3). Next, we examined whether there are associations between attitudes toward biology and knowledge of the tested concepts and misconceptions associated with them. The correlation between two variables was weak ($r = -0.15$) and not statistically significant (Figure 4).



Among the most frequent misconceptions is the statement that photosynthesis and plant respiration are the same processes which only differ in designation and which part of the day the processes take place (photosynthesis takes place by the day and respiration by the night). This misconception is more pronounced as the student move up in grade. Students in the 6th grade chose this response in 41.4 % of the cases, while this misconception is more pronounced as the student move up in grade. Students in the 6th grade chose this response in 41.4 % of the cases, while students in the 9th grade chose this response 76.9 %. Students are not aware that breathing takes place in every cell of the plant organism, but believe it takes place in a different area than photosynthesis (in another organelle). They are also unaware that breathing takes place continuously and that it is an indispensable condition of life. This misconception may be caused by how the chemical reactions of both processes taught. Most textbooks and teachers treat these reactions equally – they often forget to note that this reaction take place in another place in cell and primarily under the influence of other enzymes. Another relatively strongly represented misconception is that the plant produces oxygen during day and night. This misconception most occurred in 7th grade students (40.0 %), and least in 9th grade (23.1 %).

REFERENCES

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