

Alternative pupils' conceptions about photosynthesis and plant respiration by pupils of 6th grade of lower secondary school

Katerina Svandova



INTRODUCTION

The study is focused on the investigation of common alternative conceptions of lower secondary school pupils in 6th grade regarding to photosynthesis and plant respiration. These are abstract concepts and prove to be hard acquirable terms, not only for pupils. In this study alternative pupils' conceptions are understood as children's conceptions, misconceptions or misunderstanding. People often hold alternative conceptions about natural phenomena for the whole life. To overcome alternative conceptions pupils must become aware of scientific conceptions, the evidence that bears on the validity of their alternative conceptions and the scientific conceptions, and they must be able to generate the logical relationships among the evidence and alternative conceptions (Lawson, Thompson, 1988).

AIMS AND RESEARCH QUESTIONS

The main aim of the present study is to find out level of 6th grade pupils' alternative conceptions about photosynthesis and plant respiration with respect to gender and attitudes towards biology.

They were determined by the following **research questions**:

- Q1: Is there any difference between boys and girls in the level of alternative conceptions about photosynthesis and plant respiration?
 Q2: Is there any difference in the alternative conceptions about photosynthesis and plant respiration with the respect to favorite subject?
 Q3: Can attitudes toward biology change level of knowledge and alternative conceptions about photosynthesis and plant respiration?

METHODS

One of methods how alternative conceptions are investigated is a two-tier test. It showed that great percentage of alternative conceptions in this area; particularly pupils' and students' did not understand photosynthesis and plant respiration as related, mutually connected physiological functions. In this study there was also used a two-tier test with nineteen items. The first part of every question in the test was focused on knowledge, the second part on the explanation of answer.

The sample size was compound of 6th grade lower secondary school pupils in the Czech Republic.

The data were re-encoded in several ways, first by analysing the pupils' knowledge (from correct/incorrect answers), but also their alternative conceptions (frequency of occurrence of alternative conceptions). The 17 items regarding to attitudes towards biology was the part of the research tool, too.



REFERENCES

- Lawson, A.E., & Thompson, L.D. (1988). Formal reasoning ability and alternative conceptions concerning genetics and natural selection. *Journal of Research in Science Teaching*, 25(9), 733-746.

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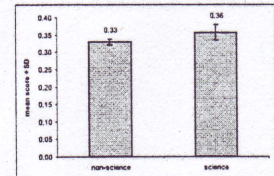
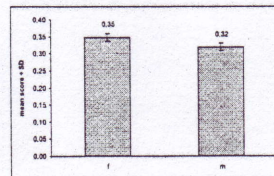
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CONTACT TO THE AUTHOR

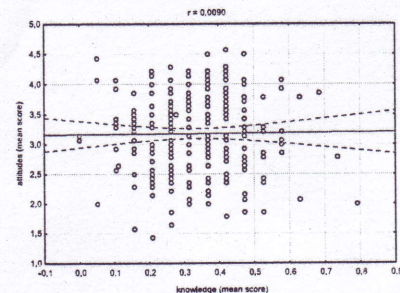
PhDr. Katerina Svandova
 Masaryk University, Faculty of Education, Department of Biology
 Porici 7, 603 00 Brno, Czech republic
 email: katkavandova@gmail.com

RESULTS

Mean score for knowledge part of the test was 0.33 (SD = 0.13) which shows a low-level knowledge about photosynthesis and plant respiration. Pupils responses were analyzed with respect to gender and favorite subject. The results were gained on analysis of variance (ANOVA). They didn't show statistically significant difference between boys and girls ($F = 2.89, p = 0.09$) and between pupils with science and non-science favorite subject ($F = 1.22, p = 0.27$).



Our next intention was to examine whether there are associations between attitudes toward biology and knowledge (and misconceptions associated with them). The correlation between two variables was weak ($r = 0.0090$) and not statistically significant.



For the evaluation of misconceptions were used evaluation of each of the items separately. We are not observing only correct answers, but we take into account primarily the percentage of individual responses in combination with all reasons of responses.

In item number 3, the investigated where the plants receive nourishment containing the energy they need to live. Frequently misconception is that the most important source of nutrients for the plant is water with dissolved substances which are absorbed through the root system. This response was chosen 72.70% of pupils in 6th grade.

3) Pupils at school were fulfilled the teachers task. They should consider where the plants receive nourishment containing the energy they need to live.

- They receive it from the soil through the roots.
- The main source, from which the plants obtain nutrients, is chlorophyll, which is located in the leaves.
- They are created themselves inside their bodies.

The reason for my answer is:

- The most important nutrient is oxygen that the plant needs to breathe.
- The most important source of nutrients is water and the dissolved substances, which are absorbed by the root system.
- Plants can produce nutrients themselves inside their bodies, source of energy for formation of such substances is primarily air and sunlight.

Year of study	Number of respondents	Content choice	Reason response			No reason	Total
			1	2	3		
6.	249	A	4.42	61.86	1.20	0.80	68.28
		B	4.01	9.64	4.01	2.40	20.06
		C	1.20	1.20	7.65*	1.61	11.66

* The correct choice and reason response
 -No response in this category

Among the most frequent misconceptions belong statement that photosynthesis and plant respiration are the same processes which are differ in sign and on the part of the day when this processes take place (photosynthesis takes place by the day and respiration by the night). Another relatively strongly represented misconception is that plant produce oxygen during day and night too. Pupils often think that oxygen release is the main meaning of photosynthesis. Between next misconceptions we can mention a statement that it is necessary quantity of oxygen, carbon dioxide and chlorophyll for photosynthesis but it is not necessary quantity of light (length and intensity of sunlight). Although pupils often choose the option that breathes every living cell in the plant body (in question 4), they deny it in question number 11 when they are chosen response "Respiration takes place only in leaves where the special apertures (pores) for exchange of gases are." This misconception can be given by idea of breathing by animals and human with special breathing organs – lungs.