

Cover letter

**On the advantage of integrated science education in the middle school years.**

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## **Introduction**

The ideas of integrated education spread out over the schools of Europe and America in the 20-th century. Nowadays educators all over the world show a keen interest in teaching integrated science. A primary purpose of integrated natural science education is the construction of the whole world picture, the development of the child's world outlook and intense correlation with an environment, the fosterage of affective experience. Integration creates opportunities for learners to investigate, conclude, process information, improve knowledge and impart information on different topics without embarrassment and leaving the barriers of traditional subjects behind. To design teaching standards for integrated teaching of science in school, one should carefully analyze one of the possible models of integrated science education emphasizing the classification of the subjects taught, define the advantages of integrated science education and understand the levels of integration (1, 2).

According to National School Education Standard physics, chemistry and biology are still taught as discrete units in Georgia. We focused on the defining the advantages of integrated science education in the middle school years in Georgia. We report here on the efficacy of integrated teaching of physics and biology in the 7-th grade. The study was aimed at finding out if integrated teaching of biology and physics helps pupils in better understanding of interconnections between biological phenomena and physical forces as compared to the teaching of physics and biology as discrete units.

## **Material and methods**

Total of 30 pupils of the 7-th grade have been recruited in the research. Subjects were divided in experimental and control groups, each comprising 15 pupils. Groups have been equalized by the IQ and sex. Experimental group had a lesson, referring to the adaptation of the shape of bird wing to fly in the air. Experimental subjects observed the bird wing (photos and the wings of stuffed birds) to find that it has a special shape - convex on the top, and flat on bottom. Afterwards pupils tested the paper models of a wing: Model N1 convex on the top, and flat on bottom and Model N 2 – flat from both sides and found out, that model N1 is lifting up during rapid movement forward while model N2 does not. Pupils made conclusion, that the special shape of the wing helps bird to lift up the body in the air. At the same time experimental subjects conducted "Paper experiment" and had been informed about Bernoulli principle,

explaining the origin of a lifting force. In the "Paper experiment" subject holds two pieces of thin paper vertically a short distance apart and blows down into the space between them. In the second series of experiment subject holds one end of a small sheet of paper in both hands. Subject keeps the held edge horizontal while the other end sags under its own weight. Subject blows steadily over the top of this horizontal edge. As usual, pupils are amazed to see that two pieces of paper move closer to each other instead of going to the opposite direction and the sheet of paper is lifted up instead of going down.

Control subjects were involved in the same class activities. However, shape of a wing and wing model had been observed and tested at the biology lesson, while "Paper experiment" and Bernoulli principle have been discussed at the lesson of physics.

At the final stage of experiment, both experimental as well as control subjects were requested to use knowledge of biology (the shape of bird wing) and Bernoulli principle to explain why bird is lifting up during the fly. They had to give an answer in a written form (half of a page or so). Answers were assessed by standard score system ranging from Fail (below 50) to A (94 -100).

### **Results and discussion**

Out of 15 experimental subjects, 33.3% scored 70-75, 20% - 85-90, 26.7% - 94-95 and the rest 20% scored 97-100. Out of 15 control subjects .33.3% scored 70, 46.7% - 75-80 and the rest 20% scored 80-85. Statistically reliable difference in the scores between the experimental and control groups has been revealed. Experimental subjects displayed better understanding of the bird fly and predominated over the control group in the precise interpretation of connections between the shape of a wing and the action of lifting forces.

Presumably, integrated teaching of physics and biology in the 7-th grade helps pupils in better understanding of interconnections between physical forces and structure and function of living things as compared to the teaching of physics and biology as a discrete units.

### **References**

1. Criddle R.A, Ryan C.N, Izett W.J, Towards tomorrow : An Australian course in integrated science. Book 1, 1980
2. Integrated science; California Science teachers association in collaboration with California teachers association (2005)