Ostravská univerzita v Ostravě

Elementary school Mjr. Ambroz Bilek and Nursery School Metylovice

CREATING PUPIL'S CONCEPTIONS BY EXPERIMENTS SUPPORTED BY ICT

Renata Spustová

Abstract:
The paper deals with finding out the level of pupils' preconceptions and the follow-up formation of conceptions in the thematic unit of Molecular Physics and Thermodynamics of elementary school pupils. Based on the found misconception, a suggestion of three experimental tasks is submitted. These are used to eliminate the incorrectly created preconceptions. The aim of the experiments is to compare the sensory perceptions of heat with the actually measured temperature values and to explain the resulting differences between feelings and physical reality. In one group, pupils work with eProLab sets supported by ICT, in the second one there is a classic experiment without any immediate feedback. The paper evaluates the level of preconceptions created in both groups.

1 Introduction

According to Mandíková [4] the preconceptions are considered to be students' intuitive ideas about how and why the world works. Doulík and Skoda [2] state that preconceptions are shaped by all the influences and experiences which have so far influenced the individual throughout his or her life. It comprises both the school and also the non-school influences. Their degree of exposure depends on the age of the pupils, on their social environment and their ability to process all the previous experiences.

The level of making preconceptions in the thematic unit of Molecular Physics and Thermodynamics is, among other things, influenced by the sensory perception of the outside world, whose every day part it is. Since the pupil doesn't know anything about the behavior of particles in the matter and does not have the opportunity to observe it closely, it results in creating space for forming misconceptions (a misconception is considered to be a wrongly created preconception) that often persist into adulthood, creating a distorted picture of the physical phenomena around us.

2 Creation of preconcepts

The process of the formation of students' understanding can be divided into two phases:

I. Determination of mastering their current level of knowledge, the preconceptions, which may conflict with the newly presented information

II. The solution to this conflict - the so-called cognitive imbalance

Using these principles, the change in pupils' conceptions is not guaranteed. Work on the transformation of pupils' preconceptions requires a lot of time. As for the wrong conceptions of pupils, called misconceptions, it is necessary to work carefully and to implement them as a possible alternative to the studied phenomena. The wrong conception of the pupils' intellectual property and questioning it results in the feeling of insecurity or inferiority. Changing the conceptions should be linked to a pleasant environment that doesn't threaten the pupil's identity. In this situation it is necessary to put emphasis on the quality of acquired knowledge, rather than its quantity. In terms of quantity, the principle of "less means sometimes more" is true. [1]

2.1 The way of determining the level of pupils' preconceptions

The questionnaires were aimed at determining the level of preconceptions and subsequently formed conceptions in the thematic unit of Molecular Physics and Thermodynamics and they studied the cognitive dimension of pupils' ideas. The pupils' knowledge and skills were examined through twelve closed and open questions in a didactic test.

Testing was conducted within two groups of eighth grade elementary school students from the district of Frydek-Mistek. Class 8.B was taught in the traditional way and class 8.A used eProLab kits that allow computer-aided measurement of physical quantities with direct visualization of the measured values, working with charts and reading from the charts. The aim of the research was to find what the difference in forming the physical concepts is in both groups of pupils who participated in the project and subsequent investigations during the period from 7.1.2011 to 30.9.2011.

As early as in the survey of preconceptions among pupils, questions 5 and 6 appeared to be problematic. These two questions deliver a contradiction between the pupils' experience proven by their own bodily sensations and the physical reality. Therefore, the preparation of the following tasks supported by ICT kits eProLab focused on the removal of misconceptions and on the proper formation of conceptions.

Question 5

In a room with a constant temperature of 22 ° C, a part of the floor is covered with a carpet and another part is covered with tiles without any floor heating. Do the tiles and the carpet have the same temperature?

a) yes b) no c) do not know

Question 6

Imagine that you stand on the tiled part of the floor in the room. Does its temperature differ from the temperature of the carpet?

a) yes b) no c) do not know

3 Creating pupils' conceptions using experiments supported by ICT

To shape students' conceptions in the thematic unit of Molecular Physics and Thermodynamics at middle school, the method of experiments supported by ICT working with the measuring system EdLaB and the software eProLab was chosen, along with pupils' own emotional description of the situation involving measuring by an infrared sensor.

In a lesson called Change of body temperature through heat exchange, pupils were supposed to work in groups of four equipped with laptops and EdLaB sets containing two green and one yellow thermometer, an IR thermometer and a base plate for connecting the sensors.

Experiment 1:

Heating aluminum wire with flame

Experiment 2:

Heat exchange between thermal conductors and insulators

Experiment 3:

The temperature of various materials in the room

Tasks are processed and recorded onto a worksheet where pupils write the results of their measurements in prepared tables. Based on their findings pupils draw their own conclusions about the subject matter and at the end they answer questions related to the chapter.

3.1 Description of experiments

Experiment 1:

Heating aluminum wire with flame

Pupils place a piece of aluminum wire in a stand. At one end they attach a yellow thermometer connected to the base plate of the measuring system EdLaB. They heat the other end with hot flame. When they start measuring in their groups, they observe temperature changes of the other end of the aluminum wire, which is not exposed to the flame. Students save the results of the measuring and print off the graphical statement of the changes in temperature, taking the values from the chart at regular intervals and entering them into a table.

After measuring, answering comprehension questions from the worksheet students derive the subject matter - heat exchange through heat conduction.

Experiment 2:

Heat exchange between thermal conductors and insulators

Pupils place an aluminum spoon and a strip of polystyrene into two identical beakers. Then they attach the green thermometers connected to the base plate to the polystyrene and to the aluminum spoon. They fill both containers with the same amount of equally hot water. When they start measuring, the groups observe the temperatures of the aluminum spoon and the polystyrene on two separate charts. Pupils save the measurement results, print off the graphs and glue them onto the worksheets. They read the results and enter the findings into a table at minute intervals.

Having completed all the measuring, students complete the worksheets through answering questions about the subject matter - thermal conductors and thermal insulators.

Experiment 3:

The temperature of various materials in the room

Experiment number 3 is based on combining pupils' own feelings with the application of acquired knowledge into practical life. The experiment is carried out twice, each time in four phases, which are recorded into a table:

The first stage is pupils' intuition - assumption, hypothesis (I think ...)

The second stage uses the evaluation of students' own heat feeling of two different materials which was acquired during its course.

In the third stage the group precisely, by an IR thermometer, detects the temperature of the materials, writing down the values.

The fourth phase is used to verify or refute the hypothesis and to explain the reason for making the error.

Experiment A) - Compare the temperature of an aluminum cup and a porcelain cup which have been permanently placed in a room with a constant temperature.

Experiment B) - Compare the temperature of the tiles and carpet in a room with a constant temperature.

Experiment number 3 resulted in the explanation why we feel objects with the same body temperature differently. It is the application of the concept of a heat conductor and a heat insulator in practice. This experiment should be followed by a pupils' discussion about other thermal conductors and insulators that students know from their own experience.

4 The results of analyzing the level of preconceptions and conceptions developed during the course

Question 5

In a room with a constant temperature of 22 ° C a part of the floor is covered with a carpet and a part with tiles without any floor heating. Have the carpet and the tiles got the same temperature?

a) yes b) no c) do not know

Question 5 is closely related to Question 6. Since this preconception is traditionally created erroneously, it was double checked. Students ignored the long-term room temperature, in other words the fact that all objects in the room should have the same temperature. Their own feelings were the key factor for their responses. 93.3% of pupils responded wrongly in the pretest. The percentage distribution of correct responses in the pretest between the two classes is approximately the same.

In the test, during the period of time when the subject matter is being discussed, the distribution of correct responses between the classes is different. The responses were better in class 8.A, in which the teaching was done through the computer supported experiments. The worksheets were directly aimed at the elimination of erroneous preconceptions by repeating several interrelated tasks. In the case of class 8.A, the pupils checked the temperature of the carpet and the tiles using the IR thermometer Vernier, which immediately showed the measured temperature value on the digital display.

Class 8.B worked with conventional thermometers and the feedback wasn't as strong and immediate as that of IR thermometers. After evaluating the test results in class 8.B, the erroneous misconception had to be corrected in order to prevent the development of permanently bad terms. Then the results in class 8.B improved, as shown in the posttest.

Question 6

Imagine that you stand on the tiled part of the floor in the room. Does its temperature differ from the temperature of the carpet?

a) yes b) no c) do not know

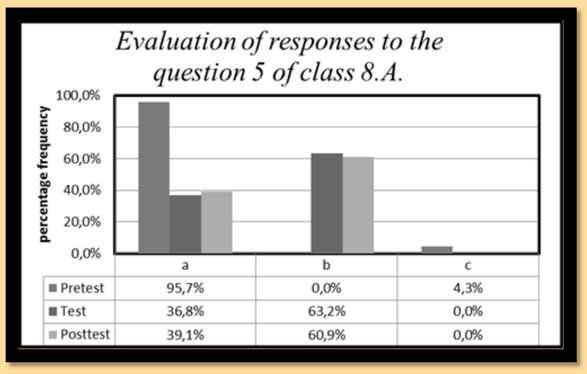
The answer to question 6 is again a typical example of ill-formed preconceptions, which often persist throughout life and schooling can hardly change these. Feeling the tiles as cold compared to the "warm" carpet leads to the conclusion that even if the room temperature is constantly the same, tiles have certainly a lower temperature because everyone can feel it "with their own feet." Thermal qualities of materials as conductors and insulators are not important, and respondents do not take these into account. Approximately 95% of pupils answered the pretest incorrectly in both classes. It is interesting that none of the students considered that answer b) could be correct, when in fact it was correct.

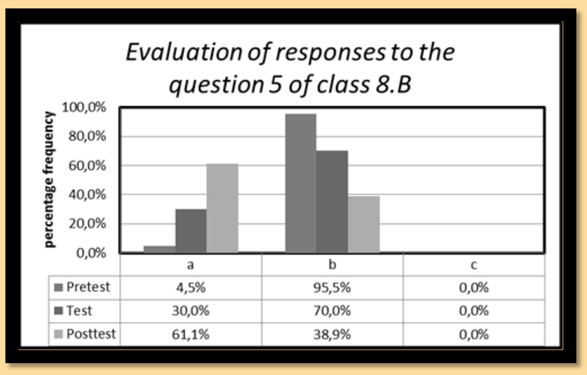
The test starts to show the difference between the perceptions of both classes. In class 8.A, where teaching is supported by computer experiments, 63.2% responded correctly. However, in class 8.B it was only 10% of pupils. The term remains in class 8.B in the field of misconceptions. The cause of significantly better results of class 8.A can be found in greater clarity of instructions, in immediate visualization of measured values through gauges eProLab and Vernier.

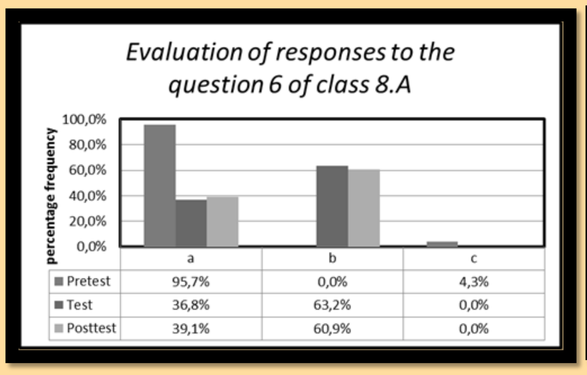
In the posttest the situation slightly changes. The teacher in class 8.B corrects the poorly developed conceptions and there is a partial improvement of results. The ratio of the right and wrong answers is 1:1. For some of the pupils though, the emotional assessment of the situation still persists.

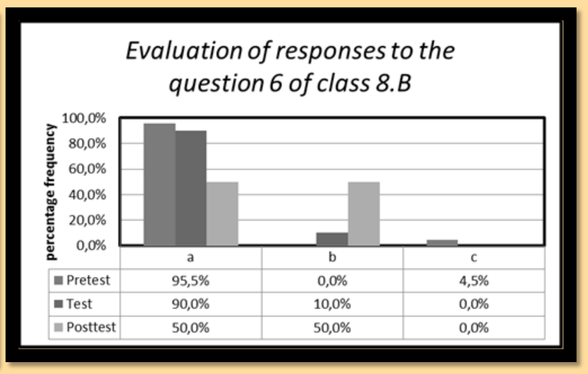
In class 8.A during the posttest, there is a slight change for the worse, which is statistically insignificant. Again the emotional assessment of the situation prevails and the percentage of correct answers is reduced by 2.3%.

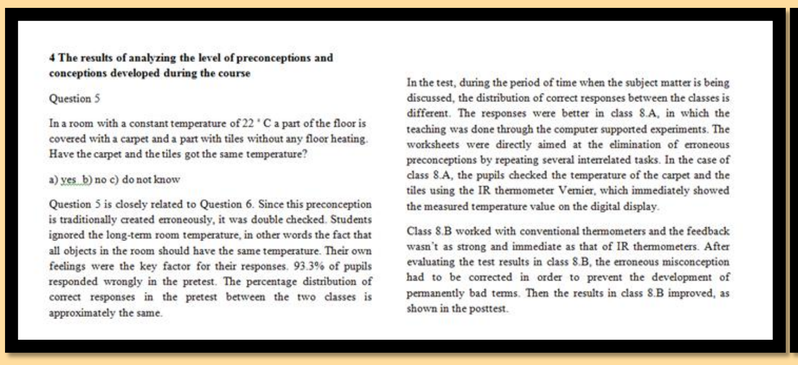
It is obvious that human feelings play a great role in the conceptualization of pupils and it is difficult to displace this from their subconscious. It is important to make the experiments as revealing as possible as these can enrich pupils' experience to repair their misconceptions and form the term correctly.











Literature

[1.] ČÁP, J. a J. MAREŠ. Psychologie pro učitele. Vyd. 1. Praha: Portál, 2001, 655 s. ISBN 80-717-8463-X.

[2.] BERTRAND, Yves. Soudobé teorie vzdělávání. 1. vyd. Praha: Portál, 1998, 247 s. ISBN 80-717-8216-5.

[3.] DOULÍK, P. a J. ŠKODA. Vliv sociokulturního prostředí na genezi vybraných prekonceptů z oblasti přírodovědného vzdělávání. In Sociální a kulturní souvislosti výchovy a vzdělávání : 11. výroční mezinárodní konference ČAPV : Sborník referátů [CD-ROM]. Brno : Masarykova univerzita, Pedagogická fakulta, 2003.

[4.] GIORDAN, A., F. PELLAUD a R.-E. EASTES. Des modèles pour comprendre l'apprendre: de l'empirisme au modèle allostérique. [online]. [cit. 2011-07-29]. Dostupné z: http://www.andregiordan.com/articles/apprendre/modeleallosterique.html

[5.] GIORDAN, A., F. PELLAUD a R.-E. EASTES. Vers de nouveaux paradigmes scolaires. Chemin de Traverse: Solstice d'Eté [online]. 2007, č. 5 [cit. 2011-07-20]. Dostupné z: http://www.ldes.unige.ch/publi/vulg/paradigmesScolaires.pdf

[6.]KOLÁŘOVÁ, R. a J. BOHUNĚK. Fyzika pro 8. ročník základní školy. 1. vyd. Praha: Prometheus, c1999, 223 s. Učebnice pro základní školy (Prometheus). ISBN 80-719-6149-3.

[7.] MANDÍKOVÁ, D. Prekoncepty žáků a studentů v oblasti elektřiny. In Sborník z konference Didfyz 2006: - Rozvoj schopnosti žáků v přírodovědném vzdělávání [online]. 2007 [cit. 2011-01-03] Dostupné z: http://kdf.mff.cuni.cz/~mandikova/prekoncepty/prekoncepty.php

[8.] ŚLIWERSKI, Red. nauk. Bogusław. Pedagogika. Gdańsk: Gdańskie Wydawnictwo Pedagogiczne[†], 2006. ISBN 83-748-9021-5.

Conclusions

The experimental tasks stated above are focused on developing pupils' key skills for learning to solve problems, for developing interpersonal relationships and communication among students. The aim of the experiments is to create the right conception of the term thermal conductivity and understanding its practical consequences. The emphasis is placed on the difference between body temperature perception of different materials and their actual temperature, on the ability to explain the physical cause of this "false" perception and the practical implications of this phenomenon. The problem still remains, after teaching, at the wrong preconceptions created in test questions 5 and 6 which are based on pupils' own perceptions of the term thermal conductivity. For class 8.B, where the measurement showed no immediate feedback, thermal conductivity terms remain still in the field of preconceptions. Class 8.A, having worked with IR Thermometers Vernier, had the possibility of immediate sensation and comparison of their physical measurements. Here, the concept developed, for the majority of students, correctly. The research shows that the use of ICT supported gadgets eProLab leads to better and more efficient formation of concepts for students thanks to clarity and immediate feedback.