Goerudio project–the use of associativeimages (models) to form conception in Natural Sciences

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Nowadays, information is unlimited resource, however one has to use it right. There are numerous definitions for explanations of physical, biological, chemical and mathematical processes, formulas with specific notions and units. Information amount accessible for student or pupil is enormous. This causes difficulties during study process for many students and pupils. Many of them try to "get information into head" by studying mechanically. However, knowledge gained in this way has little lasting value, information learned is forgotten soon and it is hard to use it in particular situations, for example, while solving tasks in Physics, Chemistry or Maths.

Many teachers are looking for solution to the abovementioned problem in their every day work, trying to select such methodological practices that encourage pupils and students to understand information and integrate it on previously obtained knowledge base. Only in depth understood information is pupil able to use in the future courses.

One of the possible solutions is developed by a group of teachers from Riga English Grammar school. In 2011, this solution was awarded 1st place in "Education Innovation Award". This is an alternative way of teaching Natural Sciences and Maths. The main idea of this approach lies in translation of complicated exact systems by simple everyday processes. Using gained associations it is possible to interconnect elementary knowledge on order of things in the world with complicated information from Natural Sciences. In this way, the process of understanding created by associations is called comprehension model. It can be created as drawing, animation, scheme etc. These are created by pupils, whereas teacher acts as the organizer and leader of this process.

"Goerudio" – the initiative of Riga English Grammar school teachers since 2011, which is being tested and developed during several study years, is the ground for international project. Seven European countries are involved in this project – Italy, Poland, Bulgaria, Romania, Spain, Slovak Republic and Latvia. In Latvia project is being led by Riga State Technical school. Also Liepaja State Technical school, Jelgava State tehnical school, Venstpils State technical school and Daugavpils Technical school.Project is financed within European Union Lifelong Learning – transversal programm – multipartner relationship KA4. Within this project, previously established web-page www.goerudio.com (it is not going to be done within this project, but it is going to be done in the future) is being significantly amended, where in systematic way comprehension models are stored. Established approach is described in educational publication "Method and Tool to Achieve Necessary Level of Comprehension" („US-China Education Review" – vol.2.,number 8,2012). The use of this approach was also presented in International Scientific Conference „The Future of Education" (2012, Florence, Italy).

As previously mentioned, comprehension models are created by pupils and used by pupils. Pupils – the creators of these models, create them during specific courses while studies. However, pupils, who did not participate in creation of these models, can use them during the study process for better understanding. On purpose, when entering web-page www.goerudio.com the slogan that is seen states: "We're too lazy to learn – let's understand!". This means that the creators of the models and actual users are the same age. Actually, pupils create study materials for each other. Sometimes, study materials that teachers create in comparison to the ones created by pupils seem to be too complicated for pupils. Of course, comparing the knowledge base of pupil, teacher has broader knowledge base and practical experience, therefore things that can be considered ordinary for teacher, might not be such for pupils. Comprehension models created by pupils for the same age pupils normally are more appealing, as used associations from the everyday life are understandable and similar as the knowledge base and experience is similar.

As previously mentioned, Natural science and Maths teachers of Riga English Grammar school have several year experience in working with comprehension models. In this work several methodological techniques are used and effective evaluation is done. Based on that, it is possible to formulate main characteristics and suggested methodological practices. Main characteristics of comprehension model are:

- **Theoretical accuracy of information included in the mode.** For example, pupil has included term "chemical balance". It is such state of the system, when the direct and indirect reactions happen in the same speed. Therefore, in the pupil's description of the process, there should be two simultaneously happening processes with the same speed. One pupil for explanation of this process uses boat with two rowers – each of them paddles in the opposite directions.
- **Easiness.** Successful comprehension model is such model, where everyday, easy understandable process is used. The key for success of the method lies in the fact that the situation used for explaining the process is in no way connected to the Natural sciences.

- **Visual perceptibility.**Model has to be visually appealing, however, it cannot be overcrowded with redundant, unnecessary embellishments. Text used for the explanation should be short and concise.

Below are several examples of pupil created modes.

Theoretical explanation.Diamagnetic materials create an induced magnetic field in a direction opposite to an externally applied magnetic field, and are repelled by the applied magnetic field. Magnetizationfield of diamagnetic is normally so small, that they are considered not being magnetic. Magnet repulses diamagnetisms. ***Model***. Skunk have self-protection method. When one tries to approach them, skunks squirt foul-smelling liquid, which scares away anyone who approaches. In this way – skunk is a magnet, but possible enemy – diamagnetic, which is repulsed.	
Theoretical explanation.Absolutely transparent fixtures are fixtures that all received energy by radiation place through them. ***Model.*** The heat radiation can be thought of as flavour that is sifted through the sieve, where the sieve is the transparent fixture that sifts the flavour (radiation).	
Theoretical explanation.Reflex is the reaction of the organism to the irritation. ***Model.***Rainbow is Sun's (sunny day's) reaction to the rain. In this case rain is as irritator and the rainbow – response reaction.	

Creation of model can be organized as:

- Individual work of pupils,
- Group work under control of the teacher.

When organizing the model creation as the individual work of pupils, they have to be notified in the beginning of each new study theme. Teacher introduces pupils with main characteristics of the comprehension models, demonstrates examples. Pupil can use any concept, process or phenomenon in order to create comprehension model. Models are created as part of the homework, using information obtained during the study course, as well as information gained in additional sources. Created model is submitted to the teacher during the last day of the particular course. Teacher evaluates the model. This evaluation is the part of the final evaluation.

However, when the models are created during group works, it is normally done within the lesson. Depending on the class, both teacher and pupils can create groups. It is optimal, if there are 3 pupils in one group. Teacher acts as process promoter and adviser. Each group presents their created model, there should be discussion on the accuracy of the model. In case of necessity mistakes should be corrected.

There are both positive and negative aspects of each approach.

	Individual work	Group work with control of teacher

Positive	Pupil consummates: • Individual ability to work; • Ability to work with information. Teacher gains objective understanding about each pupil's capabilities and abilities, therefore it is possible to plan the individual work with pupil better.	Pupil consummates: • Abilities to work in teams; • Presentation skills. Created models are theoreticallyaccurate, as teacher works as adviser and helps pupil to steer the ideas in the theoretically correct way, if this is necessary.
Negative	• Sometimes pupil created models are based on wrong or theoretically inaccurate explanation (not valid sources are used, for example, wikipediaetc). • Pupils might be impacted from similar models found on the Internet.	• Limited time of each lesson often does not allow fully cover creation of the model, therefore some part of the work has to be given as homework (for example, preparation of theoretical information or drawing up the presentation). • Limited possibilities to create models in the form of animation or video material).

Despite chosen approach, it is very important to conduct the analysis of pupil's created models. At first, model has to be analysed by teacher. Unfortunately, it is time-consuming process. Afterwards, models should be evaluated by pupils. It is better done as a group work. Pupils analyse their own and their classmate created models, evaluating both – theoretical accuracy and visual sentience, as well as can come up with suggestions. It is suggested to prepare worksheets, in which evaluation criteria are formulated in understandable way.

Research results obtained during the project approve that comprehension model creation and use in learning process of Natural Science subjects is one of the ways how to encourage pupils to use gained experience and knowledge in innovative way.