SAILS
Strategies for Assessment of Inquiry Learning in Science

ASSESSMENT OF SELECTED ASPECTS OF INQUIRY DURING TEACHING TOPIC PROPERTIES OF PLASTICS

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PRESENTATION CONTENT

- **Introduction – why IBSE?**
- **Inquiry- based activities of the topic Properties of Plastics**
- **Specific samples of verification of teaching Properties of Plastics using tools of formative assessment**
- **Formative assessment – advantages and problems (teachers opinions)**

INTRODUCTION – SITUATION IN SCIENCE EDUCATION IN SLOVAKIA

- The students of Slovak schools know a lot of separate knowledge,
  - they have problems in investigating, creating hypothesis, searching ways how to solve problems, interpreting results and collecting and presenting evidence in order to argue and draw conclusions.

- Solution: **changing the way of teaching science subjects**.

IBSE

INTRODUCTION – SITUATION IN SCIENCE EDUCATION IN SLOVAKIA

- IBSE is appropriate method which can make pupil active and interested in science.
- But, there is still an open question of **how to assess students´ performance** in this environment.
- Dominantly used summative assessment tools are not any more sufficient for the evaluation of students´ performance.
- The formative assessment tools provide ongoing feedback in order to modify teaching and learning to improve students´ attainment.

ASSESSMENT OF TEACHING OF THE TOPIC PROPERTIES OF PLASTICS WITH IBSE

USING TOOLS OF FORMATIVE ASSESSMENT

INQUIRY- BASED ACTIVITIES OF THE TOPIC PROPERTIES OF PLASTICS

Project ESTABLISH → **Unit Polymers**

Within this unit, we prepared Inquiry – based activities of the topic Properties of plastics:

- **Determining density of Plastics**
- **Combustibility of Plastics**
- **Thermal stability of Plastics**
- **Resistence of Plastics to chemicals**

INQUIRY- BASED ACTIVITIES OF THE TOPIC PROPERTIES OF PLASTICS

- Research was realized with **12 teachers** and with participation of **130 students**.
- **Task of the teachers:** teaching inquiry-based activities from topic Properties of Plastics.

INQUIRY – BASED ACTIVITIES: PROPERTIES OF PLASTICS

Activity Properties of plastics develops students´ skills:

- Searching for information
- Diagnosing problems
- Communication with classmates
- Suggesting hypotheses
- Carrying out experiments
- Data collecting and recording
- Formulation and presentation of conclusions

Activity: Resistence of Plastics to chemicals

Guided inquiry - in activity Plastic Properties:
problems are stated by **teacher** while the experiment is proposed either by teacher or pupils.

INQUIRY – BASED ACTIVITIES: PROPERTIES OF PLASTICS

- **<u>Determining density of plastic materials (PE, PP, PS, PVC) by comparing with water density</u>**

  Propose a procedure by which you can verify and compare the density of the above plastic materials with that of water. You can look up water density in the chemical tables.

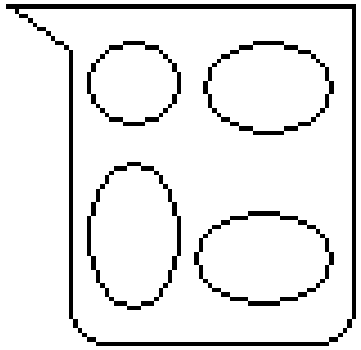
Sample of students' worksheet:

Determining density of plastic materials (PE, PP, PS, PVC) by comparing with water density

Findings:

- 1. In the picture, there is the result of the experiment to determine density of different plastic materials of PE, PP, PVC, PS. Write the names of the materials into the bubbles in such a way that it complies with the findings of the experiment.

  Picture:



- 2. Complete the text with the following expressions:

  „floats on water"; „falls to the bottom of the beaker" „bigger, smaller"

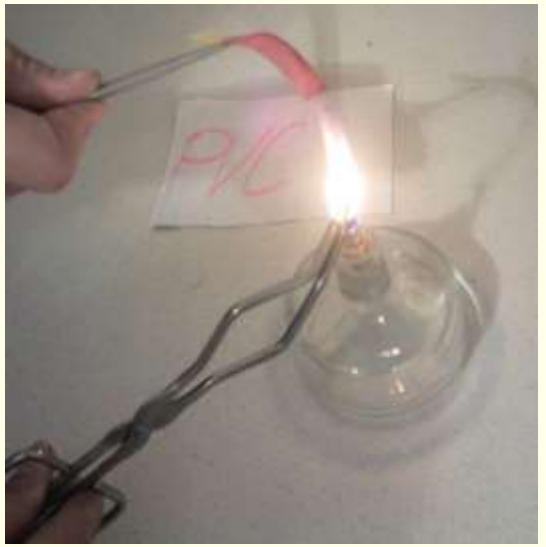
  The density of water is _____ g/cm^3.

  Polyethylene _____, therefore its density is _____ than that of water. Polystyrene _____, therefore its density is _____ than that of water. Polyvinyl chloride _____, therefore its density is _____ than that of water. Polypropylene _____, therefore its density is _____ than that of water.

INQUIRY – BASED ACTIVITIES: PROPERTIES OF PLASTICS

- **<u>Combustion of plastic materials polyethylene (PE), polypropylene (PP), polystyrene(PS), polyvinyl chloride(PVC)</u>**

  Observe and describe the changes in phases of the materials during the process of burning, describe the flame – its colour, smoke production, odour. Identify the character of fumes by means of universal indicator paper at the end of the test.



INQUIRY – BASED ACTIVITIES: PROPERTIES OF PLASTICS

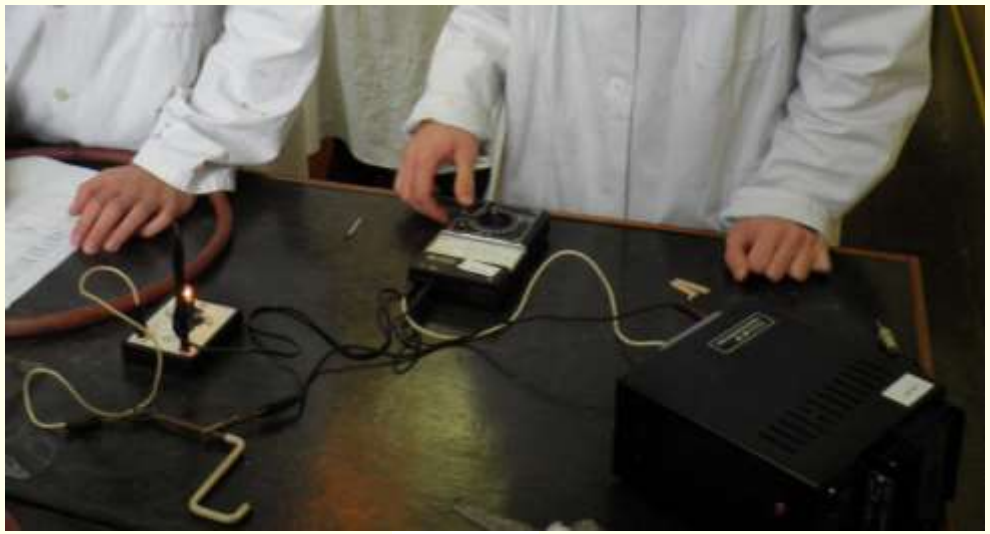
- **Beilstein's test for halogens**

  Ignite a copper wire in the flame of the burner. Use the wire to take a sample of a plastic and put it again into the flame of the burner. If halogens are present, the flame will become green.

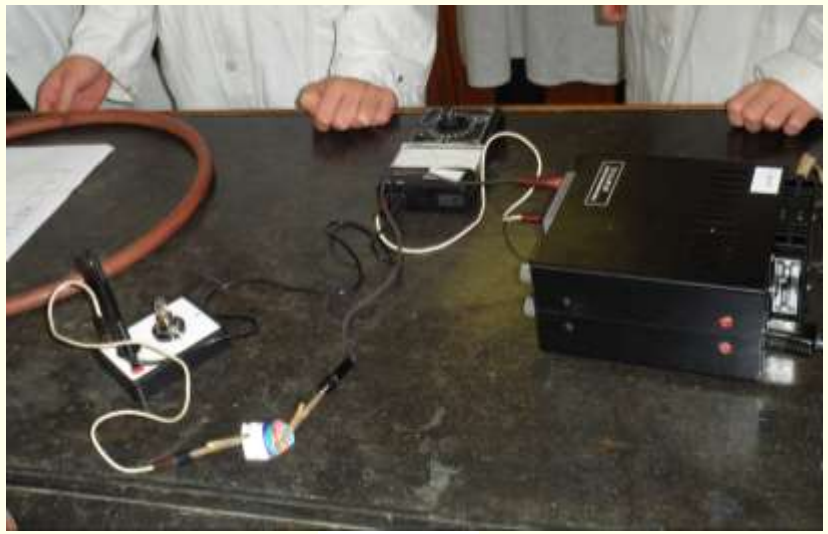
INQUIRY – BASED ACTIVITIES: PROPERTIES OF PLASTICS

- **Electrical conductivity of plastic materials**

Prepare a simple electrical circuit and connect into it a particular kind of plastic, cotton , metal and wood, respectively.



metal



plastic

VERIFICATION OF TEACHING OF THE TOPIC PROPERTIES OF PLASTICS WITH IBSE USING TOOLS OF FORMA

- **Verification of teaching:** tools of formative
with them during course Preparatory attestati
first/second attestation exam in subject of Che

Questionnaire on the assessment of metacognition

1) What did we do? 2.) Why did we do it?

3) What have I learnt today? 4.) How can I use it?

5.) What questions about the topic do I still have?

ASSESMENT OF STUDENTS´ GROUP WORK

State, how often the described situation occurred during group work:

Use the following scale for your answers:

1	*2*	*3*	*4*	*5*
almost never	*rarely*	*sometimes*	*often*	*always*

ASSESSMENT OF STUDENTS´ GROUP WORK		1	2	3	4	5
1	We discussed procedures in order to solve the given tasks.					
2	I suggested the procedure, the others agreed.					
3	The others suggested the procedure and I agreed.					
4	We formulated conclusions together.					
5	I explained to the others how to formulate conclusions.					
6	Other students explained to me how to formulate conclusions.					
7	We formulated answers to questions together.					
8	I answered questions and justified them to the others.					

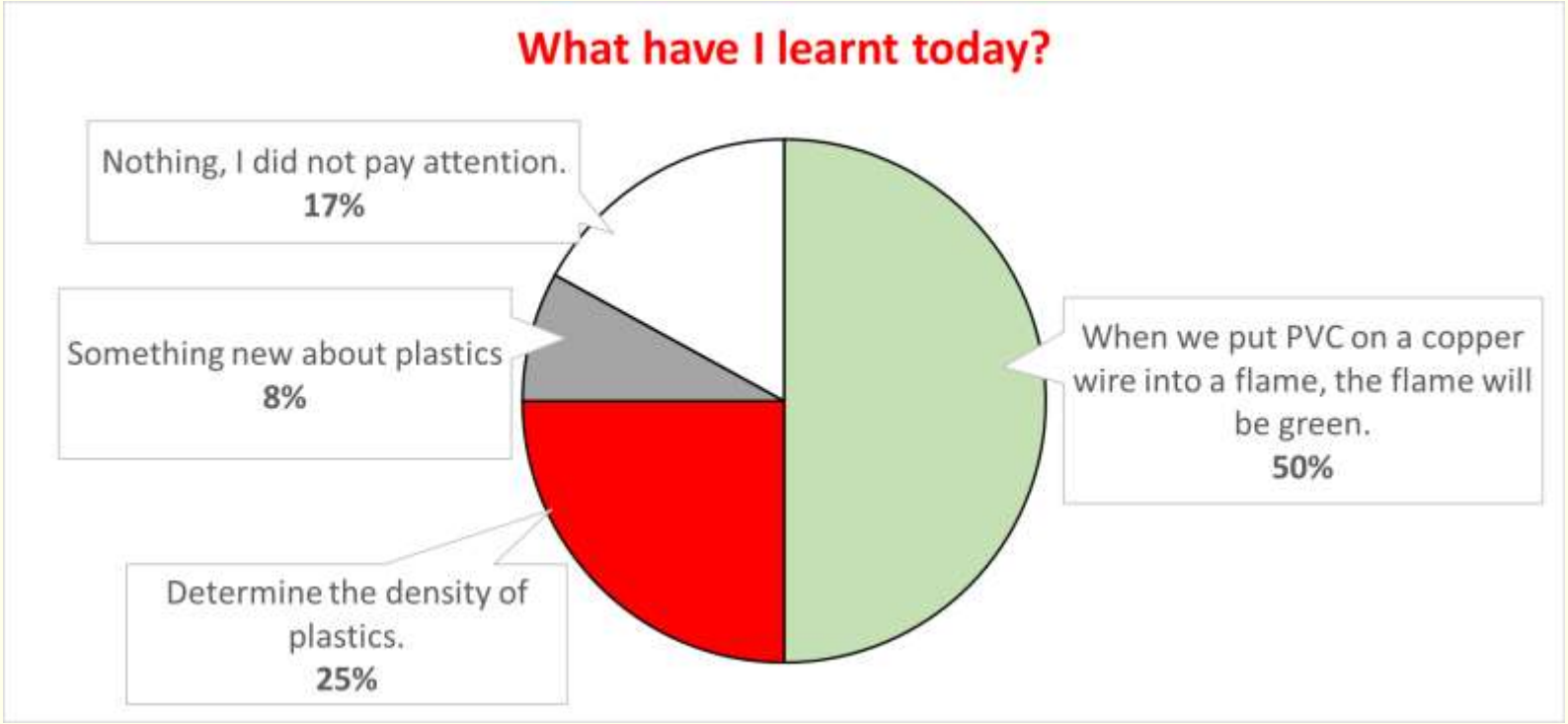
SELF-ASSESSMENT

Sample n. 1: Assessment of understanding or "What have I learnt about density of plastics with inquiry – based method?" on the basis of metacognition.

- **Students group:** 14-15 years old, 16 students of Elementary school
- **Activities:** Determining density of plastic materials polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC) by comparing with water density. Combustion of plastics – Beilstein´s test for halogens.
- **Assessment:** at the end of the lesson, students are supposed to answer the questions:

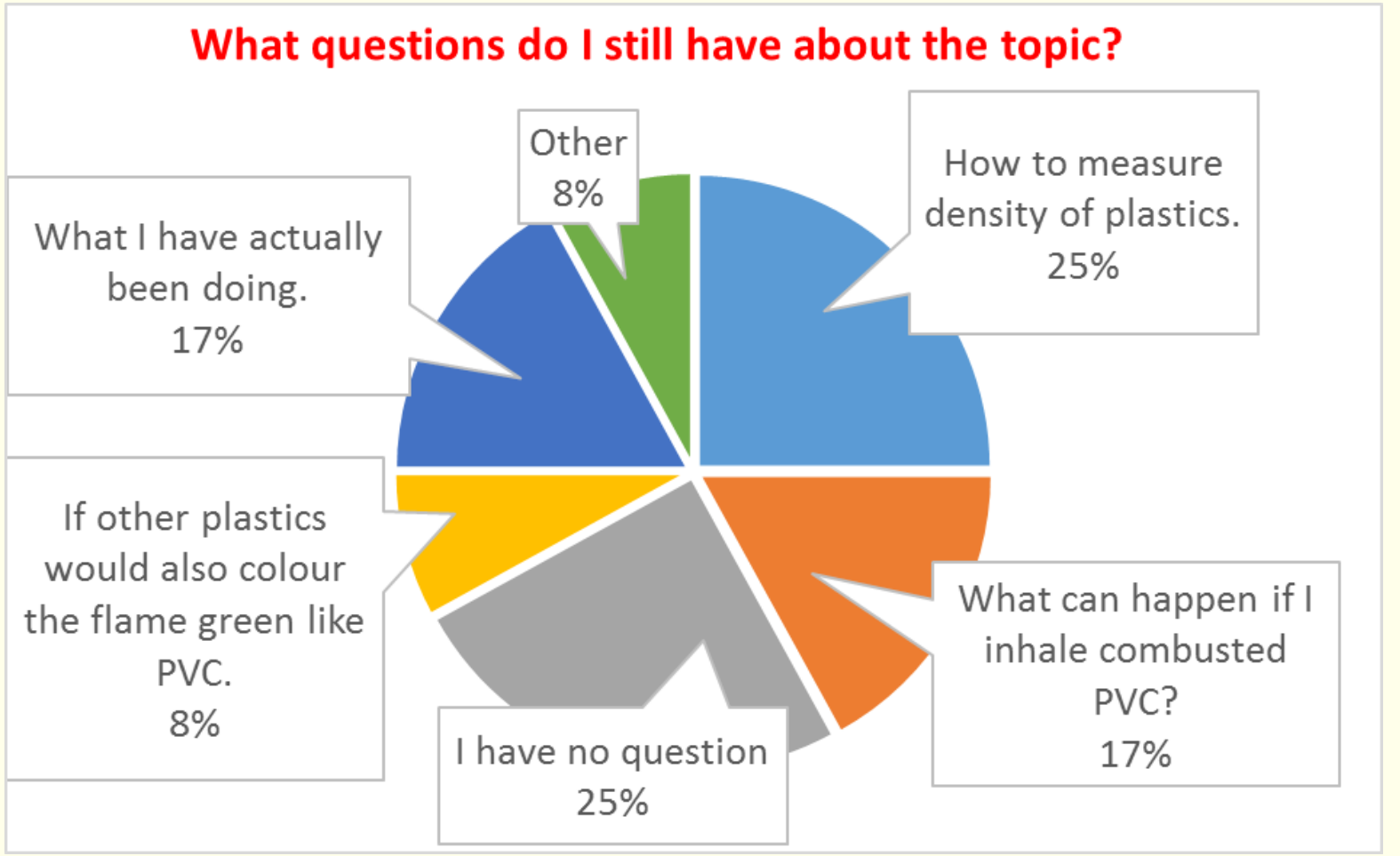
What did we do? *Why did we do it?* *What have I learnt today?*
How can I use it? *What questions about the topic do I still have?*

Sample n. 1: Assessment of understanding or "What have I learnt about density of plastics with inquiry – based method?" on the basis of metacognition.



Graph with results of metacognition – students´ answers to question What have I learnt today?

- **Sample n. 1: Assessment of understanding or "What have I learnt about density of plastics with inquiry – based method?" on the basis of metacognition.**



Graph with results of metacognition – students´ answers to question What questions do I still have about the topic?

SELF-ASSESSMENT

Sample n. 2: Self-assessment table of a student after teaching inquiry-based activities

- **Students group:** 17-18 years old, 22 students of Grammar school
- **Activities:** Determining density of plastic materials polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC) by comparing with water density. Combustion of plastics – Beilstein´s test for halogens.
- **Assessment:** students fill out a short table, which they hand in before leaving the class:

Self-assessment table of a student after teaching inquiry-based activities	
Things I have learnt today:	
Things which were interesting:	
Questions which I still have:	

Sample n. 2: Self-assessment table of a student after teaching inquiry-based activities

Self-assessment table of a student after teaching inquiry-based activities	
Things I have learnt today:	*Properties of particular plastics.* *What kinds of plastics exist. How to ignite the burner.* *How plastics are burning. Which plastics smell and drip during burning.* *How plastics are used.*
Things which were interesting:	*Behaviour of plastics during combustion.* *Burning of a Ping-Pong ball.* *Finding out how many things are made of plastics.* *The colour of flame during combustion.* *Smell.*
Questions which I still have:	*How plastics can be harmful to us?* *How to avoid problems with excessive amount of plastic waste?* *Why plastics burn in this way?* *Why don´t we learn in this way more often?* *14 students had no question.*

Sample n. 3: Questionnaire on group work assessment

Students group: 14-15 years old, 22 students of Primary school

Activities: Thermal Stability and Thermal Conductivity of Plastics

Assessment: Students evaluated group work in a questionnaire with smileys. The questionnaire was focused on self-assessment of their own work in group, their cooperation with other members, as well as students´ mutual cooperation.

Questionnaire on group work assessment

Name: Class:

Gender: Age:

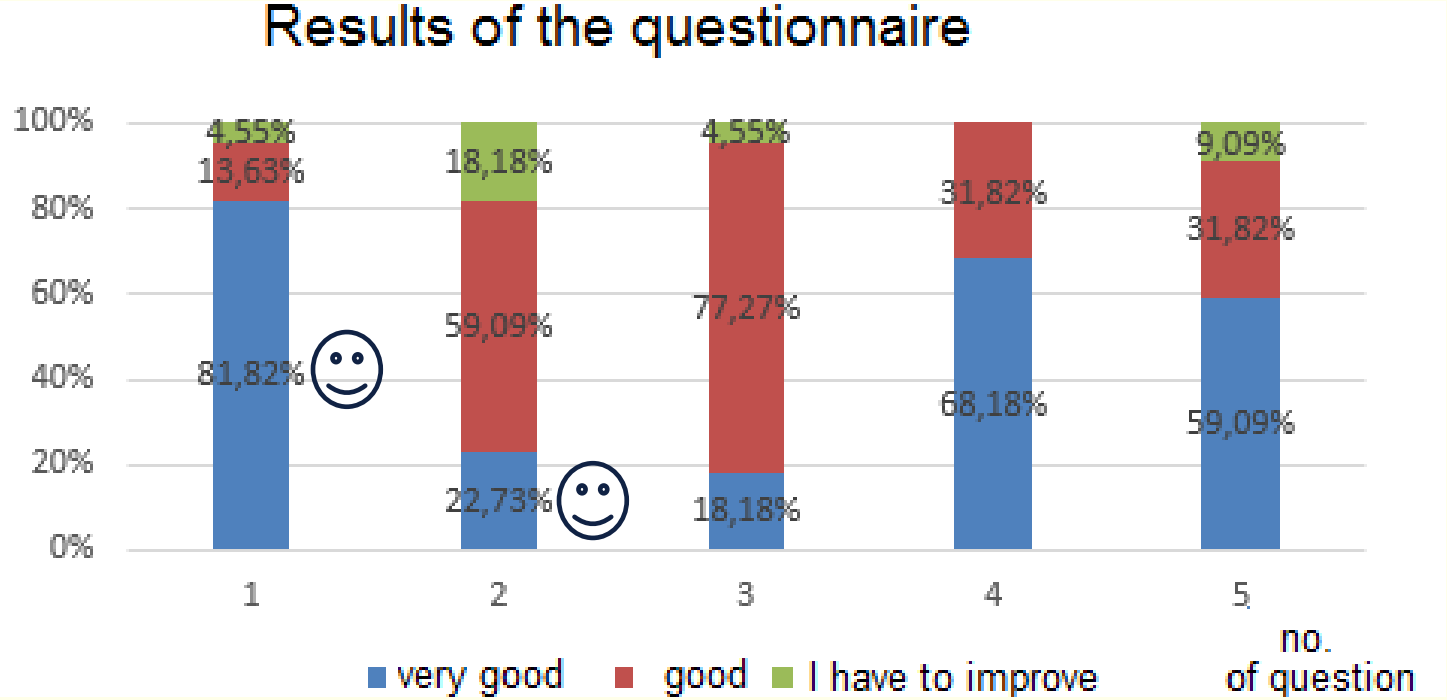
Express your opinion about working in group with the help of smileys:

very good good I have to get better

1. *How did I help during group work?*
2. *How did the other members of the group help me?*
3. *Did I make group work harder?*
4. *How did I manage to fulfil the goal of the lesson?*
5. *How did other members of the group manage to fulfil the goal of the lesson?*

Self-assessment

Peer assessment



Question

1. *How did I help during group work?*
2. *How did the other members of the group help me?*
3. *Did I make group work harder?*
4. *How did I manage to fulfil the goal of the lesson?*
5. *How did other members of the group manage to fulfil the goal of the lesson?*

PEER ASSESSMENT

Sample n. 4: Questionnaire method for peer assessment of group work

- **Students group:** 17-18 years old, 22 students of Grammar school
- **Activities:** Determining density of plastic materials polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC) by comparing with water density. Combustion of plastics – Beilstein´s test for halogens.
- **Assessment:** questionnaire for assessment of students´ group work

discussion and the design of procedures

formulation of conclusions

creation of answers to questions

ASSESSMENT OF STUDENTS´ GROUP WORK	*1* *almost never* [%]	*2* *seldom* [%]	*3* *sometimes* [%]	*4* *often* [%]	*5* *always* [%]
We discussed procedures for solving out the given tasks together.	0	0	5,3	47,4	47,4
I suggested procedures and the others agreed.	10,5	31,6	42,1	15,8	0
The others suggested procedures and I agreed.	0	0	57,9	36,8	5,3
We formulated conclusions together.	0	0	15,8	42,1	42,1
I explained to the others how to formulate conclusions.	31,6	31,6	26,3	10,5	0
Other classmates explained to me how to formulate conclusions.	10,5	26,3	42,1	21,1	0
We formulated answers to questions together.	0	0	21,1	52,6	26,3
I answered questions and justified them.	10,5	36,8	47,4	5,3	0

CONCLUSION

Formative assessment – teachers´ opinions

- *This way of assessment is very important, because it **provides feedback**. Teacher can assess better the level of student´s knowledge and on this basis, teacher **can plan the next teaching activities**.*
- *The importance for the **students** is that they **have a possibility to improve their learning**.*
- *Students learn how to assess their knowledge objectively and to compare it with their classmates.*
- *This way of assessment strengthens the teacher – student relationship.*

CONCLUSION

Formative assessment – teachers´ opinions

- *Teacher gains knowledge about subjective feelings of students, e.g. about work in groups.*
- *Formative assessment is motivating for students and in comparison to summative assessment, it is less stressful.*
- *Both forms of assessment (formative and summative) complement each other and have irreplaceable significance for verification.*

CONCLUSION

Formative assessment – problems (teachers´ opinions):

- *Pupils are unable to assess objectively – they over-estimate or under-estimate*
- *Time consuming– preparation of assessment tools, realization*
- *Weak verbal skills, weak vocabulary, inability to express opinion*

THANK YOU FOR YOUR ATTENTION