PROFILES

HANDS-ON EXPERIMENTAL ACTIVITIES IN INQUIRY- BASED SCIENCE EDUCATION

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1. INTRODUCTION

- **Decreasing the interest** of young people to study science – Cz, EU…
- Some universities in Europe are reporting a **halving in the number of students** enrolled in physics since 1995.
- **The way science is taught** in schools is considered one of the **main causes.**

1. INTRODUCTION

- It is necessary to think how to **change teaching methods** and **increase** students´ **motivation** for science.
- D**ifferent learning style** of todays´ learners – new **methodologies**.
- One of the suitable possibilities is **IBSE.**

1. INTRODUCTION

IBSE shows great promise according to the results of researches:

- increases students' interest,
- stimulates teacher motivation,
- is effective with all types of students from the weakest to the most able ones,
- supports the improvement of the gifted,
- promotes girls' interest and participation in science activities.

2. OPEN LEARNING

- OL is described as a teaching method with **no prescribed goals** or **outcomes** students have to achieve.
- Students should not be taught **only facts**, but should be made to **understand** and **explain** what they are learning. (M.Wagenschein)
- Open learning plays an **important role** especially **in** teaching through **experimentation**.
- Students do not only perform experiments like cooking according to recipes but they should **understand** what they **do and how they do it.**

3. INQUIRY BASED SCIENCE EDUCATION (IBSE)

- IBSE = IBT + IBL
- science is taught as **inquiry** rather than the **memorization** of facts and terms,
- helps students put materials into a **meaningful context**,
- prefers conceptual **understanding** and logical process skills,
- develops **critical thinking** and **supports positive attitudes** toward science (Kyle 1985; Rakow 1986).

3. INQUIRY BASED SCIENCE EDUCATION (IBSE)

IBSE

- **hands-on activities in which students conduct investigations, discover principles, and practice applying those principles in a variety of situations**

- **intrinsic motivation relate to the satisfaction of having learned and understood something or relevance,**

The traditional methodologies

- **the teacher communicates information - recall of factual information without understanding and comprehension**

- **extrinsic motivation** - it **is usually based on the satisfaction of being rewarded**

(Duschl 2007)

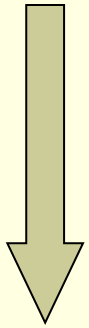
4. HANDS ON ACTIVITIES IN IBSE

- They play very important role in inquiry.
- Their implementation is task for teachers - to be **organically included** in certain teaching/learning methods.
- It is not easy to **transform science content** into the form of IBSE.
- Teachers must "learn" **how to apply IBSE** - to use hands-on activities in corresponding inquiry levels.

4. LEVELS OF INQUIRY

H. Banchi and R. Bell define according to experience how much guidance is provided to students by teachers four levels of inquiry:

- confirmation inquiry
- structured inquiry
- guided inquiry
- open inquiry



STUDENT'S INDEPENDENT

4. 1 CONFIRMATION INQUIRY

- conformation the knowledge of principles, concepts and theories
- the results of experiments are usually known in advance
- is useful in the beginning of IBSE when a teacher's goal is to develop students´ experimental and analytical skills - specific inquiry skills, such as collecting and recording data

4. 1 CONFIRMATION INQUIRY

Example:

In the frame the curriculum content oxidation-reduction students ***confirm the sequence of metals in electrochemical series****. They choose one of the metals and insert it into the different aqueous solutions of metal ions. They observe chemical reactions and changes with metals. They summarize all their observations in a table and analyze their results. On this base they make conclusions and compare them with theory.*

4.2 STRUCTURED INQUIRY

- the teacher has an influence on procedure - helps students in inquiry by asking appropriate questions
- students generate an explanation supported by the evidence they have collected
- is very important for development of student's abilities to conduct more open-ended inquiry
- is very common in elementary science curricula as well as confirmation inquiry

4.2 STRUCTURED INQUIRY

Example:

Students conduct the same experiments as in the first level but electrochemical series should not be told them ahead. ***The task for students is to determine which metal is less reactive*** *using comparing reactivity of metals during oxidation-reduction experiments.* ***The goals and rationale of this inquiry is to enable constructive building of the electrochemical series.***

4.3 QUIDED INQUIRY

- the teacher is the "guide of inquiry„ -he encourages students using the research question and provides students with guidance about their investigation plans
- students are less supported - they design procedures to test their questions and the resulting explanations
- the teacher provides students with guidance about their investigation plans
- students should to have experiences to be able designing their own procedures
- outcomes of inquiry are better when students have had a lot of opportunities to learn and practice different ways to plan experiments

4.3 QUIDED INQUIRY

Example:

To develop deeper understandings of metal oxidation-reduction reactions we ask students ***to predict on the base experiments*** *which metals it is possible to use to metal plating and why.*

4.4 OPEN INQUIRY

- is the closest to "science inquiry„
- students should be able to derive questions, design and carry out investigations, record and analyze data and draw conclusions from the evidence they have collected
- it requires a high level of scientific reasoning and cognitive demand from students
- it is suitable for development of gifted students

4.4 OPEN INQUIRY

Example:

During the previous explorations, students made conclusions on the base ***experiments*** *which* ***were planned by the teacher.*** *In open inquiry students* ***carry out their investigations*** *so they have to suggest procedure of experiments, which metals and aqueous solutions of metal ions will be used. They need to include their focus question, a prediction, a detailed plan for how they will carry out their investigation, and the data table (if necessary) they are going to use.*

5. PROJECT PROFILES AS A SUPPORT FOR TEACHERS IN IBSE

- PROFILES = Professional Reflection-Oriented Focus on Inquiry-based Learning and Education through Science
- PROFILES deals with supporting teachers in application IBSE in instruction
- PROFILES improves the teachers skills in implementation IBSE in instruction
- enhance students' intrinsic motivation to learn science and their individual competencies such as proper decision-making abilities and abilities in scientific inquiry.

5. EXAMPLE OF PROFILES MODULE

The name: motivational form

Three phases:

- **Scenario** – short story that provokes the interest in solving the problem

- **Realization** - students carry out hands on activities, collect data, solve problems

- **Evaluation and recapitulation** of the performed work.

5. EXAMPLE OF PROFILES MODULE

- **The name**: ***Brushing up on chemistry***
- ***Scenario -*** *motivation*

Why toothpaste is used for cleaning?

Which ingredients are responsible for it?

Could using of toothpaste be dangerous?

Is it possible to prepare toothpaste at home?

5. EXAMPLE OF PROFILES MODULE

*The teacher assign to students the task of going to a supermarket and **buy** a small selection of toothpastes: whitening, with baking soda, for gingivitis.*

*Following that they identify from the product packages the **ingredients of each brand** and under the teacher's guidance about a general reference to the **composition of toothpastes** they **divide the ingredients** into particular groups, depending on **their action/functioning**.*

5. EXAMPLE OF PROFILES MODULE

- **Realization:**

*Students carry out hands on activity preparing **home-made toothpaste**, using available at home materials. Subsequently they test the **effect of homemade toothpaste** by comparing with a commercial brand of toothpaste. The cleaning power of the both kinds of toothpastes is compared by testing their ability to remove food colouring from egg shells.*

5. EXAMPLE OF PROFILES MODULE

Home-made toothpaste

5. EXAMPLE OF PROFILES MODULE

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Evaluation and recapitulation:

- *The project is completed with an evaluation and recapitulation in class of the performed work.*

- *Students answer questions, present their results of hands on activities or observations and etc.*

5. EXAMPLE OF PROFILES MODU

The example of questions:

- *Research the nine categories of ingredients in toothpastes. Give an example of each and explain its function. What is the purpose of each ingredient in your homemade toothpaste? What categories of ingredients are missing from the home-made toothpaste?*
- *Which toothpaste felt more abrasive to you in the touch test in step 10? Why is an abrasive useful in cleaning? Can an abrasive cause any problems in cleaning teeth?*
- *Compare the pH values of tap water, home-made toothpaste, and commercial toothpaste. How could pH affect the cleaning ability of toothpaste?*
- *How do plain water, homemade toothpaste, and commercial toothpaste compare in cleaning ability in steps 6 and 8?*
- *How does fluoride help to prevent cavities? Does it pose any risks to users? Would your home-made toothpaste help to prevent cavities? Does it pose any risks to users?*
- *If you wanted to make“whitening” toothpaste, what ingredient could you add to your mixture? Design an experiment to test your new toothpaste.*

6. CONCLUSIONS

- **IBSE** is a way which may be taken **to increase knowledge and skills** of the students in science.
- **Hands-on activities** play a crucial role in IBSE because they are beneficial to **promoting students´ interest** and participation in science activities.
- These implementations of hands-on experiments develop **students' knowledge and skills in constructivist** way.
- PROFILES Project offers hands-on activities which **were prepared by experts** and **verified in teaching** by experienced teachers.

Thank you for your attention.

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