

SCHOLA LUDUS CREATIVE-DISCOVERY WORKSHOP IN FORMAL AND NONFORMAL EDUCATION

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INTRODUCTION

Creative-discovery workshop (CDW) SCHOLA LUDUS is based on learning by pupils' own discovering. It is based on authentic learning by playing [1] as a strategy led to gaining serious experiences, knowledge and competencies. The SCHOLA LUDUS learning cycle is applied [1, 2].

Description of workshop "Modeling the sound propagation" depicts benefits of the CDW to the development of key universal and physics subject competencies and pupils' conceptions.

STRUCTURE OF CREATIVE-DISCOVERY WORKSHOP

1. *Assignment of the problem* - action with the key case and its description. The key case is usually attractive demonstration – real and therefore always a complex process – or a provocative statement. The key case motivates. It is a reference case. It can be introduced e.g. by provocative problem task, short skit or a video-recording.
2. *Looking for answers, solution* – mapping and modeling of parallel cases. Parallel cases are for example pupils' conceptions about the process, suggestions of a solution, or several different demonstrations of the same process. [1]
The teacher drags pupils in her/his own "exemplar" thinking process – manages the development of pupils' learning process through questions, through her/his own contributions to hypothesizing, experimenting, modeling, etc..
3. *Evaluation of results* – includes abstraction, defining discovered concepts, formulating of the knowledge, setting bounds to its validity, embedding the new knowledge into existing structures, consciousness of the thinking progress and investigation of a top case as an application of gained knowledge in new context. Thought-out alternation of individual and team work, small group and whole class discussions keeps pupils active and allows developing their cognitive, communicational, inter- and intrapersonal competencies.

CREATIVE-DISCOVERY WORKSHOP "MODELING THE SOUND PROPAGATION"

Modeling in school physics

Modeling as thinking process is declared in the state educational program - Physics for lower secondary education as one of developed physics subject competencies. Teaching physics is based on modeling and investigation of models. But in reality pupils cannot recognize, when they work with model and when they work with physical reality, in what condition is the model valid, what are limits of models' application.

Even many upper secondary students think that everything that they learn in science lessons is real and accurate. This is why they are not able to recognize observation and theory, resp. model. [3]

To improve understanding of the term model and develop the modeling ability are two of the main goals of the CDW "Modeling the sound propagation".

Description of the creative-discovery workshop "Modeling the sound propagation"

CDW "Modeling the sound propagation" consist of two main parts: Introduction to modeling and Modeling the sound propagation. Required time refers to one/two lessons variant of CDW.

1. Introduction to modeling (8 / 15 minutes)

The key case = paper airplane

Action: Throwing a paper airplane

Description: What is this? Is it really an airplane? What are common and different signs of paper and real airplane?

Parallel cases = a castle dummy, cords with bells as a model of the laser object protection (example from a movie), a bag as a model of the corral in sports training.

Mapping: What similarities and differences can we identify among parallel cases (models and originals)?

Modeling: Discussing attributes - signs, bounds and processes in selected models and originals.

Abstracting: What can be neglected, when and why? - Abstraction and idealization in process of models' creation (key case, parallel cases).

Embedding: Why we use models? Various criteria – finance, size, safety, accessibility, simplification, repeatability, slowdown/speed up processes etc.

Top case = sound propagation

Valuation: Let's try to create our own models!

2. Modeling the sound propagation (35 / 65 minutes)

The key case = Ball model as a provocation

Action: Throwing a ball in different conditions.

Description: Observing principles of balls' motion.

Parallel cases = waves on the string, waves on the water surface, movement of the spring (Fig.1) and string net (Fig.2)



Fig.1 Spring model



Fig.2 String net model

Mapping: Comparison proceeding of the ball model and the sound propagation (direct experimentation and discussing everyday experience).

Modeling: Comparison of parallel cases and the sound propagation, look for assigning components and bonds in the original and selected models.

Abstracting: Summarization of sound propagation patterns.

Embedding: Formulation of models' limitation. Formulation of advantages, disadvantages and limits of investigated models. Looking for the "best" model according to selected attributes.

Top case = "My own model"

Valuation: Suggestion of pupils' own models, mutual presentation of results, recommendation on particular models' improvement.

Benefit by the CDW "Modeling the sound propagation"

Addresses of the CDW "Modeling the sound propagation" can gain new facty knowledge and acquire or develop universal as well as subject competencies:

1. Factly knowledge

Knowledge about sound propagation:

- sound propagate in all directions;
- sound can be reflected, transmitted or absorbed by the barrier;
- sound propagate in gases, liquids and solids;
- material medium is required for sound propagation;
- pitch, loudness and tone quality;
- harmful effects of the sound.

Knowledge about modeling – understanding the relation original – model.

2. Developed competencies

Information: to chose appropriate information, apply gained information in problem solving.

Cognitive: to compare similarities and differences of two objects – the original and the model, fluency, flexibility, originality, redefinition, elaboration (I try to suggest a better model, improve my own model to stand the proof).

Interpersonal: team working, coordination.

Communication: to present information (clear and logic expressions), to hear comments, suggestions and questions, dispassionate argumentation.

Personal: assertiveness, enforce my own opinion in an appropriate way, accept a critic, self-motivation (I can be initiative, I am able to discover new knowledge).

Subject: to formulate the problem or question, to formulate hypothesis and verify them, to observe physical phenomena; design simple experiment and realize it; to sight analogies and utilize them; to model one process whit another; to be able find deficiencies in argumentation.

The creative-discovery workshop "Modeling the sound propagation" in formal and non-formal education

The creative-discover workshop "Modeling the sound propagation" was verified in condition of non-formal education (30 children aged 9-14, participants of summer camp SCHOLA LUDUS: Experimentáreň) and in conditions of formal school conditions (18 pupils

aged 14-15, Alexander Dubček lower secondary school in Bratislava). Methodical sheet for teachers and pupils worksheets were prepared and used in school education.

Concepts of a model and modeling in context of physical education were strange to pupils at the beginning of the CDW. After the part "Introduction to modeling" pupils were able to work with selected models. They accepted provocative Ball model of the sound propagation and advised its' advantages and disadvantages. Comparison of selected models and everyday experience about sound propagation eventuated in discovering and formulation of basic properties of sound and principles of sound propagation. Form of creative-discovery workshop allowed teacher to detect and overcome pupils' misconceptions.

The sharpest differences were shown in testing of selected models of the sound propagation and in suggestion of pupils' own models. Better results were achieved by children in summer camp, nevertheless they were younger. Pupils' comparison of models and reality was insufficient; they didn't suggest any suitable model. This can be explained by abundant experience with active learning methods among summer camp participants. Furthermore many participants took part in the summer camp repeatedly. In camp one animator works with group of five children. Pupils are not used to formulate their own conceptions and change them actively. It is not enough to learn active only in one workshop per year. To change learning approach requires long-term systematic effort.

CONCLUSION

Discovery-creative workshop is at the top of active learning and teaching forms with regard to the demands imposed on teachers. But, at the same time, CDW is at the top of learning forms directed by pupils. Pupils learn in their own tempo – CDW is therefore a form suitable for slower pupils, for pupils with diagnosed learning disturbance, as well as for talented pupils. CDW allow active involving of pupils with problem behavior; everybody can access the task appropriately to her/his own abilities.

A crucial point of the creative-discovery workshops can be a possibility that pupils may handle mistaken solution. This risk is minimal if the teacher expects misconceptions and use them as advantage in order to understand how science occurs. Pupils should understand that even negative experimental result, shift the scientist towards.

REFERENCES

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