THE EDUCATIONAL ROLES OF VIDEO PROGRAMS WITH EXPERIMENTS

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Abstract
The contribution presents the overview of educational roles of video recordings of physics experiments. The first set of possibilities to use video recordings based on experiments is focussed on school teaching and learning. Video clips and video programs are used in all teaching/learning phases: motivation, exposition, fixation, application and diagnostics. The second set of possibilities to use video recordings in physics teacher training. New teacher training technique is the creation of video programs by teachers. The important part of teacher training is the formation of pedagogical skill of the didactic path creation. The use of ICT during creation of video recordings is matter of fact.

1. Video recording of an experiment and/or a real experiment
Today’s multimedia ICT technologies are accessible to schools, teachers and students. Teachers can use the video recordings of experiments during lectures, while students can use them for preparation at home. It is possible to distribute and create the video recordings fairly easily. The future is sure to bring further streamlining and simplification of the creation and use of video recordings during lectures of physics, science and technology. Physics experiments are very suitable objects for video recordings and are also often created and presented by use of ICT (YouTube 2009).

A real physical experiment is a basic and irreplaceable educational tool in physics (science) education. From a constructivistic point of view, decisive importance lays with student experiments, which the student realizes himself and takes in with all the senses.

Nonetheless situations arise when it is possible or even necessary to replace a real experiment with a video recording. Without a doubt, it is necessary to replace a real experiment in these cases:

- Dangerous experiments: This occurs when it is necessary to use dangerous substances or work in a hazardous environment.
- Long-term experiments: These experiments require a longer realization period than we have during lectures available.
- Very fast experiments: This occurs when it is not possible due to their quickness to observe them fully by the senses and it is necessary to use a slow-motion recording.
- Microscopic and macroscopic experiments: Objects which are used during the experiments are too small or on the contrary too big for their realization during lectures.
- Financially demanding experiments: Some experiments require long and costly preparation.

In addition to the types of experiments mentioned, it is possible to find other groups for which it is appropriate or necessary to be undertaken as a video recording.

Video recordings are however also appropriate for additional technical reasons. To these belong above all video recordings for whose realization the teacher does not have available proper tools or sufficient knowledge for their successful realization.

Video recordings of experiments, however, can be purposefully and effectively used as a substitute or complement of real experiments. These possibilities will be introduced later.

2. Video clips and video programs with experiments
There exist different kinds of video recordings of experiments, which differ namely by the number of experiments and the length of recording. Video clips consist of one short experiment; longer video programs consist of several experiments. Video clips contain a single experiment typically recorded during one camera shooting and last a few seconds. Video programs are compiled from a series of experiments which are edited and last a few minutes.
Useful during lectures are single video clips as well as entire video programs. Video recordings of experiments and their animation are a part of interactive multimedia educational computer programs.

Our long-time experience in the production of video recordings and development of their applications in the physics education has resulted in principles of production, of which we would like to highlight the following:

- Educational objective setting: acquiring of knowledge and/or skills
- Learner target group setting: age, type of course etc.
- Semi-professional or professional recording and editing equipment: quality video-camera, dispersive reflectors, background surface, editing software etc.
- Appropriate equipment and materials for experiments: small size, vivid colours etc.
- No “talking head” of narrator, only the hands of experimenter on the screen
- The narrator only complements the image
- Optimal realization team: physics education expert, film-director, cameraman

Especially for video programs:

- Structured screenplay based on didactic path: not only a set of isolated video-clips, multi-purpose teaching/learning applications, didactic path (from phenomenon to application etc.)
- Combination of modules: real experiment (qualitative and/or quantitative with measurement), animations of experiments, demonstrations of materials, apparatuses, phenomena, applications, excursions (field trip, laboratory, manufactory), text (formulas, captions)
- Optimal authors team of screenplay: physics education expert (person in charge), physicist, teacher, film-director
- Inclusion of all teaching/learning phases: motivation, exposition, fixation, application, diagnostics

3. Video recordings in teaching/learning phases
Video recordings can be used in all teaching/learning phases: motivation, exposition, fixation, application and diagnostics (Trna 2005). It is appropriate to combine the application for video recordings with real experiments. In individual teaching phases, the following video recordings have proved to work well:

Motivation phase:
- paradoxical experiments
- aesthetically beautiful experiments and presentation of phenomena

Exposition phase:
- details of the experiment
- experiment in slow-motion
- experiment combined with its animation
- simulation experiment

Fixation phase:
- repetition of video recording with students’ commentary
- video recording as guideline for demonstration of the experiment

Application phase:
- creation of an alternative experiment in addition to the video recorded experiment
- use of video recorded experiment when solving problems or projects

Diagnostic phase:
- concurrent student explanation of video recording of experiment
- real student demonstration of experiment from video recording

It is evident that an experiment appropriate for a particular phase should be adequately adjusted to that phase. Physics teachers should be trained to be able to realize these adaptations in physics education.
4. Video recordings in physics teacher training

Video recordings of experiments give several possibilities of applications in physics teacher training:

- Instructional video recordings of experiments used in the training courses of experiment demonstrations
- Self-video recordings of demonstrations of experiments by experienced teachers for process analysis
- Creation of video recordings with the ICT utilization

Production of video recordings of experiments by the teacher during his training of conducting experiments leads to the formation of a complex pedagogical skill, into which physics knowledge of demonstrated phenomenon, experimental and didactic skills are integrated. An excellent final product of an experiment conducting training course is a project consisting of video program. Its core is the didactic structure (path) leading from the demonstration of a physical phenomenon to its practical application.

As an example we mention a part of the screenplay involving a didactic path (see Fig. 1).

![Figure 1: Didactic path of video program: Heat and Work](image-url)
5. Example of video programs with experiments
In line with above mentioned guidelines of video recording creation, we created in recent years a series of video recordings “Physics in experiments” (Direct film 2009). These video programs have a didactic structure and are applied not only in official school education, but also for informal learning outside of the classroom (Veletrh 2009). As an example, we would like to mention one of these video programs (Fig. 2):

![Video program „Physics in experiments: Electromagnetism"

6. Conclusions
Video recordings in the form of video clips or video programs are an important tool of physics (science) education. Teachers in pre-service and especially in-service preparation must be acquainted with the creation and application of video recordings during classroom instruction. Their pedagogical skill to create and apply video recordings must be sufficiently developed. The fast-paced development of ICT leads to their incorporation in the preparation of teachers, especially for in-service training in the form of lifelong learning.

References
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