ANIMATION MODELS IN E-LEARNING OF SCIENCE

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ABSTRACT
The article deals with the simulation models in e-learning applications which are the basis of controlled animation. Visualization of simulation experiments with the computer has a great significance in teaching-learning process. Animation helps not only to increase the demonstrativeness but also allows the student to acquire new knowledge based on her/his own observation and own experience of the working with the model. Such computer models have to be relevant and implemented with the aid of on exact mathematical model. Computer animation has its meaning also for electronic presentation of a teaching material. Mathematical model includes a large amount of information about the object modelled and enables the student to extrapolate a lot of knowledge about the object which is the subject of teaching or learning. The paper describes the main principles of animation which is based upon modelling simulations´.

KEYWORDS
E-learning, modelling, simulation, animation, simulation experiment.

E-LEARNING, E-LEARNING MATERIALS, E-BOOKS

It is possible to use a very simple definition of e-learning: E-learning is an intellectual process during which the learner acquires new knowledge and skills using electronic learning tools together with adequate information and communication technologies.

Very often for Internet courses or other educational processes classical textbooks or materials in electronic form are used. Most of educational multimedia CD ROM applications offer static or unchangeable items like text, images, photos, sound, music, video-sequences, animations, without any user interaction. But only a few applications are well structured and allow the user to acquire new knowledge in an active way by own experience with simulation models.
The effectiveness of e-learning depends also on the quality of learning materials and on additional information sources used. The e-learning applications have to be created with deep knowledge of problem and pedagogical mastery.

The main features of a good e-learning application are: strong motivation, learner-friendly atmosphere, relevant knowledge, adequately structured content, active learning supporting control, feedback, and interactive communication, monitoring the activity of the learners and personal learning style of the learner.

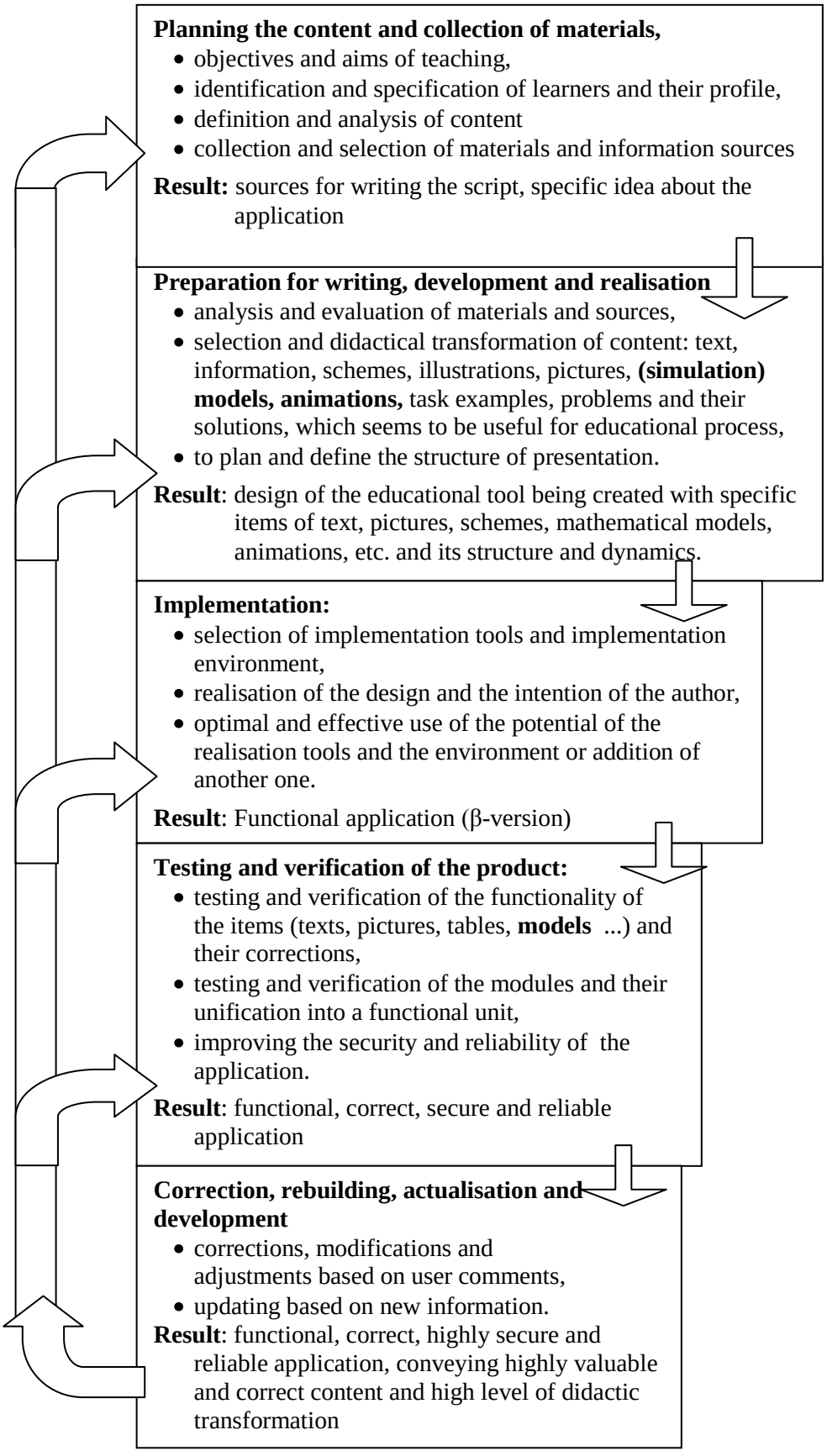

Figure 1. Schema of electronic didactical application creation and development

DEVELOPMENT OF E-LEARNING APPLICATION

The development of an e-learning application is a complicated and a very serious process and obviously it is a team-work. It needs a good knowledge of the subject, excellent educator mastery, and knowledge about the possibilities of multimedia and computer aided learning/teaching and skills and experiences with realisation tools.

The process of development of an educational multimedia application has interactive character and conveys several steps. It is possible to differentiate at least 5 phases of this process:

1. Planning the content and collection of materials, identification of learners (users),

2. Preparation of the information items with pedagogical mastery and adequate transformation of separated content (texts, schemes, pictures, models, animations, etc.) definition of structure and dynamics of each window and information item and the design of communication and presentation windows.

3. Implementation – to select the correct and most powerful realisation tools for all items and the suitable learning environment for their integration;

4. Testing the application – the first it is necessary to test the application in virtual conditions and at least in real condition;

5. Correction and rebuilding the application – users of all e-learning applications have a possibility to contact the author by e-mail or to express their opinion on the product by another way. The author must respect all well-founded critical objections on the product and make an adequate correction and rebuild the application. An updating of the content is also necessary.

Figure 1 illustrates the content of each phase of creation of multimedia educational application for e-learning. Each phase has a defined content and result.

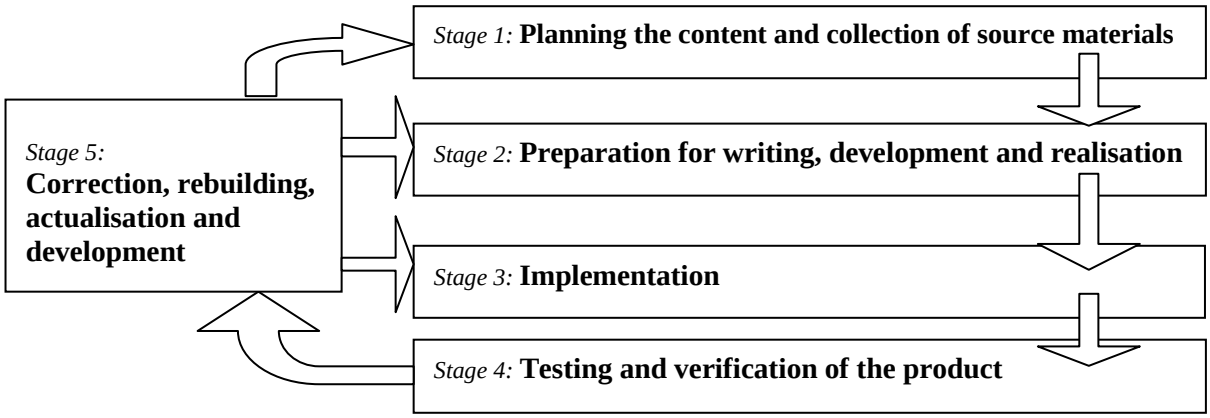

Figure 2. The life cycle of didactic application

ANIMATION MODELS IN EDUCATION

Animation models used in electronic presentation have various intentions. Many of them have only ***illustrational*** character. This animation makes the presentation more demonstrative; the learning is more interesting and may increase the motivation of the learner. This type of animation allows learners to create virtual environment and virtual situation for learning. Illustrative animations may be replaced by video-sequences (Hauser, 1998).

Many didactic models are ***explanatory*** in character**,** serving as a demonstrative explanation of the focus of study, and for intensification of effectiveness of the teaching matter. Many of these models enable *acquiring of the new knowledge based on self-observation, and on a basis of different experiment realisations with the help of a model. Idealisation* and *abstraction* have a very important role in the process of didactic model creation. It helps if the *idealisation* and *abstraction of* the model is simply, and without redundancy. This point of view is very important as well, as it determines what is and what is not important for the research we want to perform on the object (Skalka, 2002).

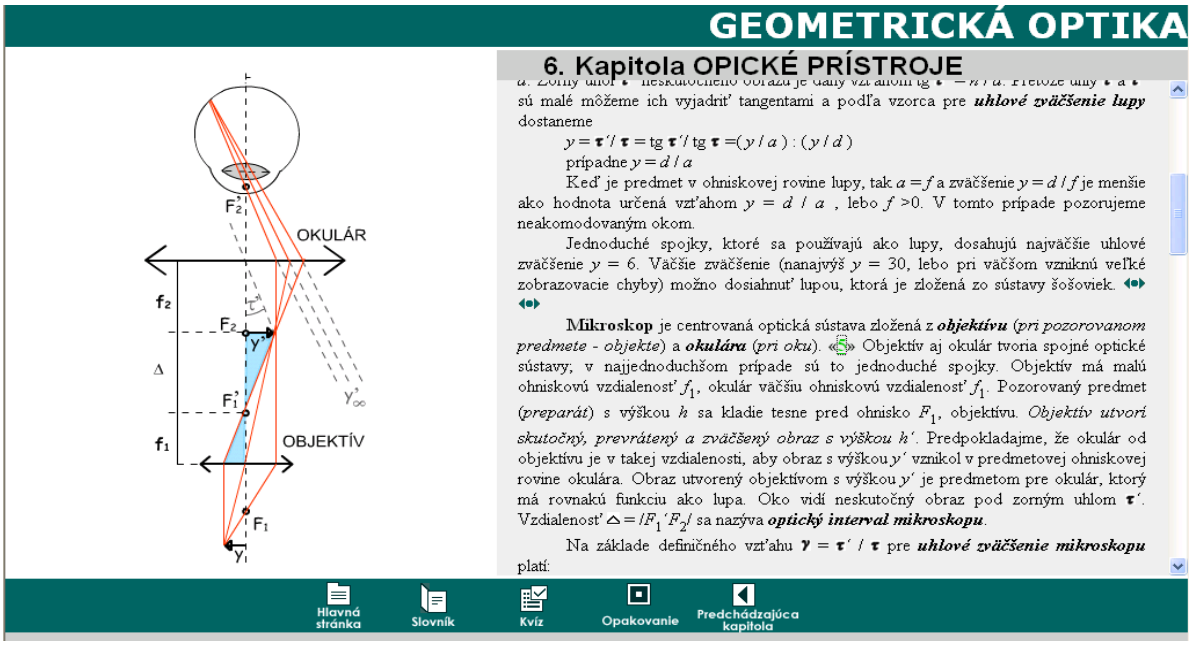

Figure 3. Basic principles of microscope – explanatory animation in geometrical optics e-books

Animations based on computer ***simulation models*** play an important role within didactic purpose animation. Parametrically controlled simulation models allow visualisation of the result of different experiments, focusing upon gaining knowledge about the object being modelled. Simulation model is based on exact mathematical model realised by an adequate numerical method on a computer. To create an exact mathematical model is possible only by the use of theory of modelling and simulation (Šafařík J. et al., 1986).

$$x(t) = x_0 + v_{xv}t + \frac{mv_{x0}}{\kappa}\left(1 - e^{-\frac{\kappa t}{m}}\right)$$

$$y(t) = y_0 + v_{yv}t + \frac{mv_{y0}}{\kappa}\left(1 - e^{-\frac{\kappa t}{m}}\right)$$

$$z(t) = z_0 + v_{zv}t + \left(\frac{mv_{z0}}{\kappa} + \frac{m^2 g}{\kappa^2}\right)\left(1 - e^{-\frac{\kappa t}{m}}\right) - \frac{mg}{\kappa}t$$

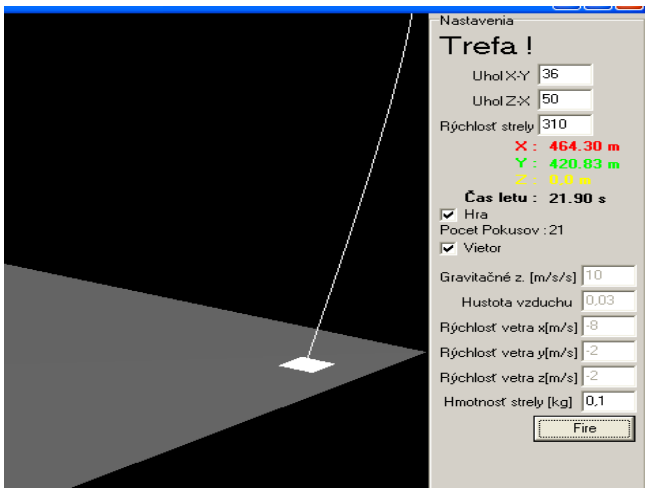

Figure 4. An interactive parametrical controlled animation of the moving object in 3D projection

On the basis of the mathematical model it is possible to derive the functions for controlling the drawing of moving part of scene. Parameters x, y and z for elementary point of the moving object track in the presence of a gravitation field in time t express the equations shown in Fig 4. The dragging force caused by an environment of a specific density and its own velocity. All parameters, which may be defined by the user, are in the interactive window shown in Fig 4.

All simulation experiments must be controlled to require learners to gain as much knowledge of the studied object as possible. Students must be led to gain this knowledge, eventually controlled in a suitable way. Simulation experiments must be carefully prepared and they should lead to fulfilment of didactic goals.

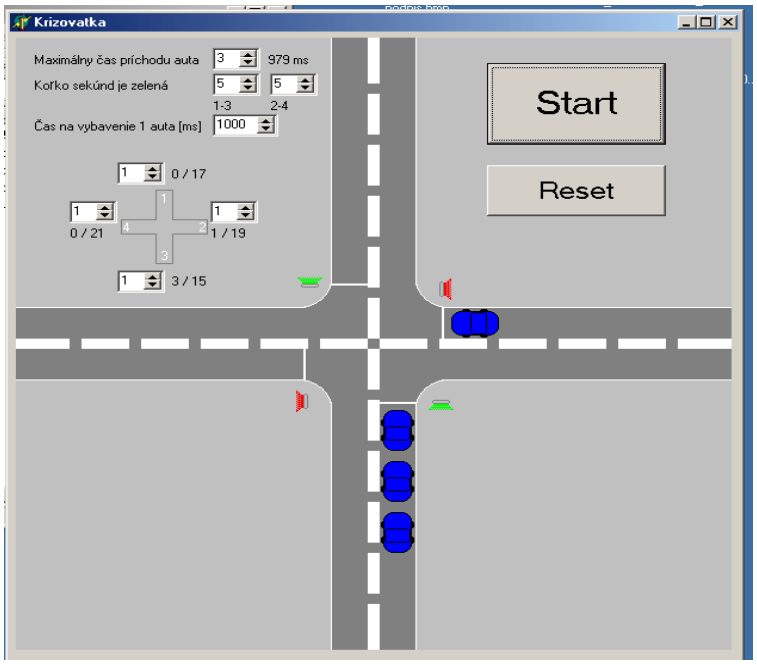

Figure 5.
Animation model of a crossroad

The crossroad system is based on the theory of query systems. The input of cars to the system is controlled by random events. The time of random events is the output of a programmed random number generator by defined properties.

CONCLUSION

Creation and use of electronic teaching and learning tools to support e-teaching/e-learning is an actual problem in education. Attention is oriented to correct hyper-structures of teaching material, didactic transformation, computer presentation, and interactivity based on active learning by simulation models. Information presentation by an animation based on simulation models play an important role in learning. Suitable animations of simulation experiment, demonstration of events taking place in a modelled system contribute to:

- rapid understanding of the function of the system and different states of the modelled system (consequently also the real system)
- examination of impacts of external inputs on the system
- specification of the elements of the system and setting their parameters, determining relationships between its elements, and so gain assumptions for optimal configuration of wanted properties of the system (prognosis)
- rapid understanding and interpretation of experimental results. The reconstruction of particular situations in modelled system is subsequently quite simple.

E-learning has a great potential for the future. It is a powerful tool not only for several distance courses but also for life-long education. E-learning is suitable also for permanent actualisation of knowledge and for removing the "secondary information illiteracy" of educated people.

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