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SUPPORTING OF SIMULATION AND VISUALISATION THROUGH ICT IN THE EDUCATIONAL PROCESS

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Introduction

- Significant development of information and communication technologies and especially the Internet boom brings new possibilities in computer science education at all levels of the educational process. Information technology has provided new innovations to sustain constructing an artificial educational environment by means of computers.
- Computer simulations in science education often go into virtual reality applications. The virtual reality is distinguished by unique sorts of interaction, that responds to users' behaviours and actions. It is considered to be a new model of computer-based learning, that provides the individual learner with a wider range of scientific vision.
- Virtual laboratory is a computer simulation, which enables essential functions of laboratory experiments to be carried out on a computer is called a virtual laboratory. They offer the opportunity to simulate real equipment and experiments.

The importance of visualization and simulation in mathematics education

- In mathematics education it is important to represent and visualize various mathematical concepts, relationships and practices, respectively algorithms. Visualization is usually implemented through different models. The model may take the form of real mathematical device, but may also be implemented in a suitable virtual software environment.
- Haptic and virtual modelling has particular importance in the stages of cognitive processes in mathematics. About the pivotal role in the effective use of handling activities in mathematics education says the document Research on the Benefits of Manipulatives, which states that the correct understanding of mathematical concepts is necessary to pass three stages of learning. These stages, respectively levels of learning, are briefly characterized in the table.

The importance of visualization and simulation in mathematics education

Concrete stage	Representational stage	Abstract stage
A mathematical concept is introduced with manipulatives, students explore the concept using the manipulatives in purposeful activity	A mathematical concept is represented using pictures of some sort to stand for the concrete objects (the manipulatives) of the previous stage; students demonstrate how they can both visualize and communicate the concept at a pictorial level.	Mathematical symbols (numerals, operation signs, etc.) are used to express the concept in symbolic language; students demonstrate their understanding of the mathematical concept using the language of mathematics.

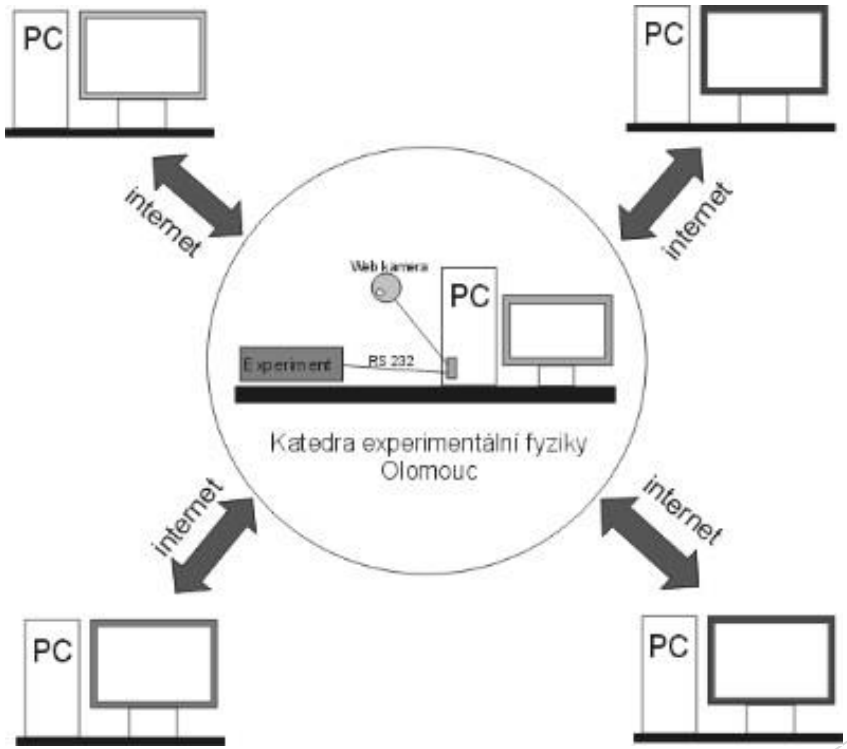
The importance of visualization and simulation in mathematics education

Meaning of visualization especially in geometry confirms van Hiele theory, which defines and describes the level of geometric thinking.

- *Level 0 Visualization*
- *Level 1 Analysis*
- *Level 2 Abstraction*
- *Level 3 Deduction*
- *Level 4 Rigor*

Materials for creating virtual laboratories in Science Education

Educational professionals consider the importance of integrating information and communication technology in science learning, as to facilitate studying many scientific phenomena that cannot be studied experimentally due to its danger, or lack of time to complete the experiment. Furthermore, it will help the student in investigation and searching, which are considered the main aims of teaching science.

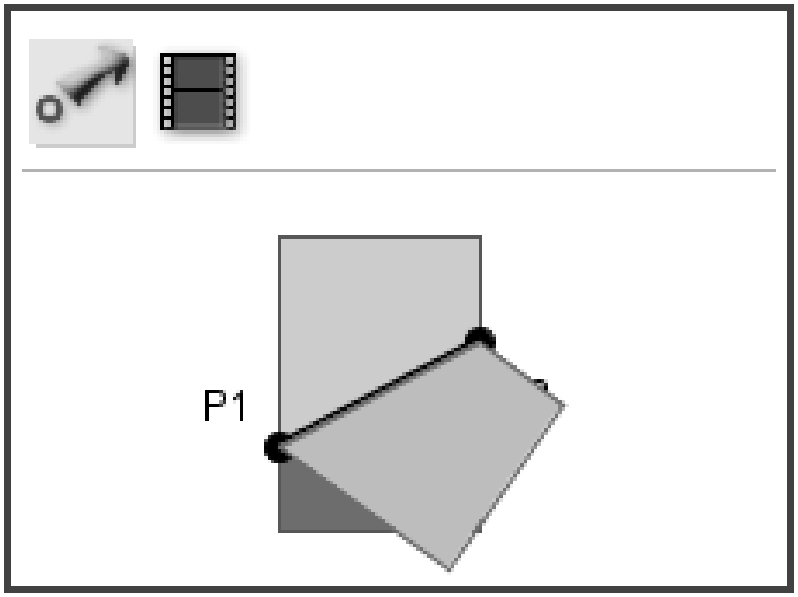


Materials for creating virtual laboratories in Science Education

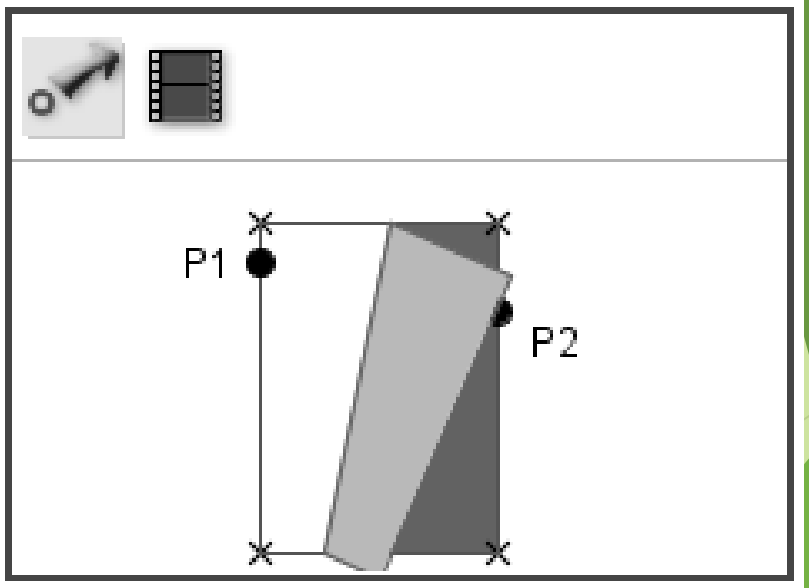
- When real experiment is replaced by a computer model, the experiment therefore takes place in the form of a simulation. Virtual laboratories have emerged above all on the Internet (World Wide Web). However, these experimental virtual laboratories in JAVA format (and also those in VRML and Shock-wave-Format) mainly represent classic simulations, which are not intended to represent laboratory experiments in a realistic fashion. Simulations which attempt to represent the real laboratory experiments as closely as possible we call virtual labs.
- Laboratory experiments can be described as virtual when the experiments are controlled not by direct manipulation of laboratory equipment, but by means of a computer, which is linked up to the actual laboratory equipment via a network (for instance, via the WWW). This type of virtual laboratory is called remote laboratory.

Materials for paper folding and its simulation in a dynamic geometry environment

Mathematics teacher has for creating appropriate models in geometry currently available dynamic geometric systems (DGS).

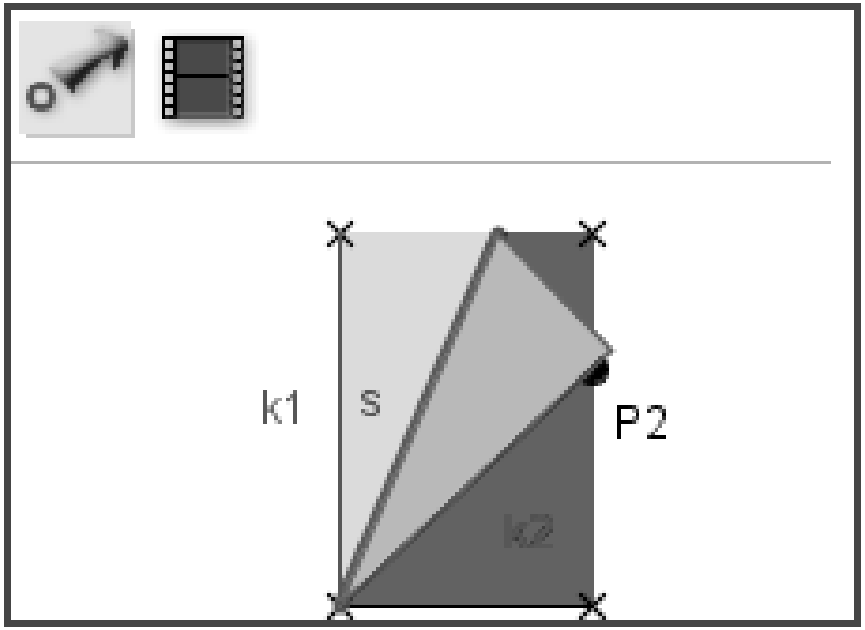


Model of the axiom A1: Given two points P1 and P2, there is a unique fold that passes through both of them.

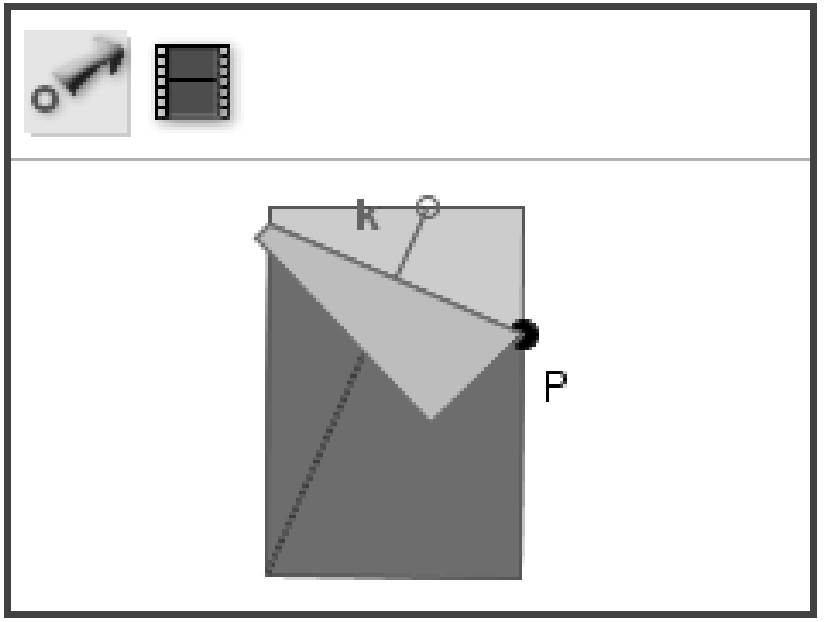


Model of the axiom A2: Given two points P1 and P2, there is a unique fold that places P1 onto P2.

Materials for paper folding and its simulation in a dynamic geometry environment



Model of the axiom A3: Given two lines k1 and k2, there is a fold that places k1 onto k2.



Model of the axiom A4: Given a point P1 and a line k1, there is a unique fold perpendicular to k1 that passes through point P1.

Using of manipulative geometry

Geometric structures of mentioned axioms are actually very simple. But the transition from a manipulating activity of making fold for searching lines representing different folds in the planar design is not elementary. The advantages of combining the both methods (folding and constructing) in mathematics education is to develop the skills of students:

- to reflect the properties of geometric figures and properties of identical views;
- to acquire practical and theoretical experience and skills of reading and decrypting the original images and real models;
- to analyse folding procedure.

This means that it creates a space for the students:

- for formulating questions and searching for answers e.g. about the conditions of existence of searching objects,
- for verification of the properties of a geometric shapes and of properties of isometries, but especially
- for experimentation and simulation of dynamic interactive environment geometry.

Conclusions

- Virtual laboratory as an educational technology provides an advanced individualized learning perfectly meets the educational needs and provides a high level of flexibility and freedom from constrains of time and place. One of the most important features of virtual reality is the easily and continuous material update aiming to attain learning objectivity and interest.
- With the increasing popularity of virtual educational technology, globally and locally, the development of virtual learning environment became an important field of science which has its own basics and principles.
- The learner is constrained to the theoretical method in acquiring knowledge, rarely allowed to apply this knowledge practically. This is due to several reasons including; the lack of laboratory devices, the risks that may result from applying some scientific experiments, and the high cost of materials The above display demonstrates the need to apply virtual learning environment in teaching science.

Conclusions

- Paper folding is an unusual way to study some geometric properties, particularly of geometric shapes. An important principle in mathematics is to acquire "active mathematical experience". Elegant addition to practical activities in the discovery, investigation and problem solving can be modelling through folding paper using of Euclidean geometry principles in a dynamic geometry environment and comparison of strategic approaches in problem solving.
- Paper folding in dynamic geometry systems can be served as a tool for presentation of virtual reality in mathematics education. DGS is an environment for pupil’s experiments and it is one of kind of virtual mathematical laboratory.

Conclusions

- Virtual Lab Concept was defined as "laboratory experiment without real laboratory with its walls and doors. It enables the learner to link between the theoretical aspect and the practical one, without papers and pens. It is electronically programmed in computer in order to simulate the real experiments inside the real laboratories.„
- Visualisation through simulation in science education helps pupils to understand new notions, relationships between them and incorporate this new knowledge in existing structure. It is important for development of different levels of children's thinking in science education. Simulation is possible to use in many school subjects of science education, for this reason it is possible to show interdisciplinary approach (see also the website http://www.scientix.eu).
- Real experiment is impossible to change through virtual experiment in educational process. The role of the virtual experiment is such supporting tool for better understanding of principles of demonstrated phenomena. If teacher hasn't possibility to realize real experiment, he/she can use virtual experiment using computer simulation.

Thank you for attention!

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