WebMatika.sk – School Mathematics in the ICT Environments

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Characteristics influencing education in ICT Environments:
- visualization,
- representation,
- interactivity and
- dynamism.

Internal tools of Dynamic geometry systems (DGS) allow to create geometric models that satisfy all these characteristics. Development of interactive and dynamic models in DGS is based on traditional Euclidean constructions carried out by virtual compass and ruler.

The website www.webmatika.sk was created to popularize resources of electronic means of mathematics education in Slovakia. The main goal is development and distribution of electronic resources for teaching mathematics at primary and secondary level.

Dynamic geometry systems (Cabri Geometry, Compass and Ruler) and professional graphic system Macromedia Flash are among the most important software means used in developing interactive contents of the website. Properties of DGS allow for the active implementation of the *method of virtual manipulation* in mathematics teaching and exploration of (but not limited to) geometric shapes and their attributes.

Fig. 1 www.webmatika.sk

Webmatika.sk contains mostly
- mathematical animations and
- geometry assignments (problems, exercises).

Pre-designed animations help unpack elementary mathematical concepts and procedures and assignments allow a solver to explore them using compass and ruler and common construction methods.

References

- OLSON, A., T.: Mathematics through paper folding. http://vidyaonline.org/arvindgupta/paperfolding.pdf
- http://kahuna.merrimack.edu/~thull/omfiles/geoconst.html
- http://www.cut-the-knot.org/pythagoras/PaperFolding/index.shtml

The poster has been worked up as a part of grant projekt called *School Mathematics in ICT Environment (MŠ SR KEGA 3/6021/08)*.

Animations

The main purpose of mathematical animations is
- *represent fundamental and derived mathematical concepts, definitions and*
- *demonstrate algorithmic procedures.*

Among other aspects, a correct didactical transposition should be in the focus when school mathematics content is to be processed into animated electronic material.

Software platforms for animation development in combination with tools of DGS allows to create
- animations for demonstrations,
- animations with limited interactivity and
- interactive animations.

Animations based on DGS platform

Majority of school geometry problems is based on discovery of properties of geometric shapes and relationships among them. DGS contain tools that allow creation of simple animations (animations of points, tracing points). Preserved interactivity of the environment after exporting the activity as a web page is a benefit of using systems of dynamic geometry.

Fig. 2 An animation created in dynamic geometry system C.a.R.

Animations based on Macromedia Flash

Webmatika contains didactical materials explaining fundamental geometric concepts and procedures, for example transferring line segments, graphical sum and difference of line segments, comparing line segments, and concepts and procedures related to circles and angles. Some animations contain video sequences embedded into Flash applets. According to the type of video used, the animations are created in combination with
- *virtual video* (screen capture video),
- *real video* (camera recording).

Fig. 3 Animations created in Macromedia Flash

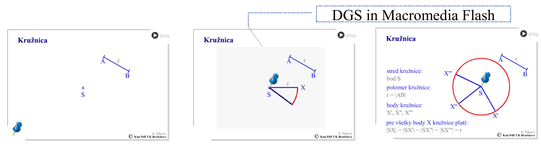


Fig 4 Animation created in Macromedia Flash with virtual video captured in Cabri II Plus using its animation features.

C.a.R. assignments

Compass and Ruler (C.a.R.)
C.a.R. is DGS, that offers tools for development of interactive geometric drawings. It emulates traditional euclidean geometric constructions with a benefit of seeing the dynamic change of the construction when changing input parameters. Other attributes of C.a.R.:
- Java platform; it allows simple html export containing Java applets
- Open Source software; includes free documentation, examples and tutorials,
- simple installation, intuitive control,
- tool analogous to other DGS.

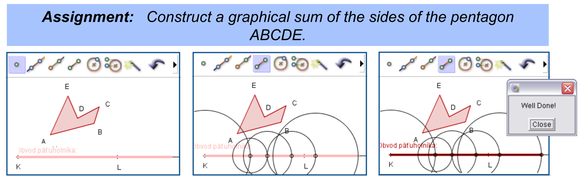


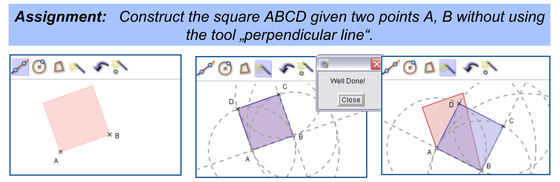
Fig. 5 C.a.R. – assignment and its solution with a positive feedback

What is a C.a.R. assignment?

C.a.R. assignment is a task that is supposed to be solved by a solver. C.a.R. assignments belong to newer methods of practicing mathematics and geometry knowledge in the ICT environment. Benefits include:
- *selection of tools allowed in a construction to solve the assignment* – the selection is made by an assignment developer;
- *necessity of explicit specification of the solution* (target object);
- *automatic control of target objects* – the controls takes into account only the final target object(s), not the method of construction.

Interactivity in assignments

During the process of solving a C.a.R. assignment, the assignment is only partially interactive. They assume full interactivity only after the target object(s) is (are) successfully constructed and feedback message appears. Newly constructed objects keep their properties and interactively change. Original (colored) solutions are being deformed according to changes in given objects (fig. 6 shows how the target object – a square has been deformed).



Obr. 6 C.a.R. assignment, its solution and the problem with the original solution after changing the position of the point B.

Paper folding in DGS

Axioms of paper folding in DGS

Studying the principles of paper folding, its procedures and properties of folded shapes, can be facilitated by the use of DGS. In general, paper folding is based on seven axioms known as Huzita - Hatori or Huzita - Justin axioms:

A1: Given two points P1 and P2, there is a unique fold that passes through both of them.
A2: Given two points P1 and P2, there is a unique fold that places P1 onto P2.
A3: Given two lines k1 and k2, there is a fold that places k1 onto k2.
A4: Given a point P1 and a line k1, there is a unique fold perpendicular to k1 that passes through point P1.
A5: Given two points P1 and P2 and a line k1, there is a fold that places P1 onto k1 and passes through P2.
A6: Given two points P1 and P2 and two lines k1 and k2, there is a fold that places P1 onto k1 and P2 onto k2.
A7: Given one point P and two lines k1 and k2, there is a fold that places P onto k1 and is perpendicular to k2.
Note: The geometrical interpretation of two axioms (A6, A7) is impossible with compass and ruler.

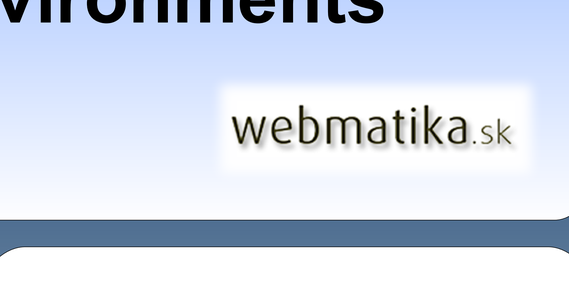


Fig. 7 Simulation of paper folding axioms in DGS C.a.R. A1, A2, A3, A4, A5

A model of an „almost“ regular pentagon

A combination of manipulation of paper folding with its virtual simulation in ICT allowed to discover that the ratio of lengths of sides of a rectangular sheet of paper, of which it is possible to fold a regular pentagon, is invariant. The conclusion is:
A regular pentagon can be formed by folding any rectangular sheet of paper, the diagonal and a longer side of which form an angle measuring 36°.

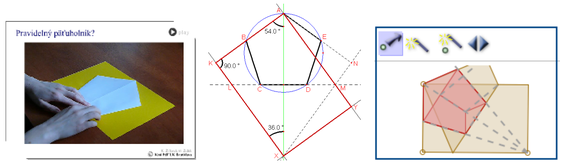


Fig. 8 Modeling a regular pentagon by paper folding and its simulation in DGS environment.