

INTERACTIVE LEARNING MATERIALS WITH DYNAMIC GEOMETRY BUILDER OR DESTROYER OF GEOMETRIC UNDERSTANDING?

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STATUS QUO

The third wave of human civilisation, a post-industrial society called

non-visible civilisation of the 21st century

Information/post-information society characteristics

RECEIVING - PROCESSING - DISSEMINATING

huge amounts of information pieces

in the virtual non-visible world

by means of rapidly developing new ICT

using digital media with

limited lifespan and validity.

STATUS QUO

- ▣ Dynamic mathematical software solutions and computer algebras cannot be neglected in nowadays maths education.
- ▣ Wide choice of remarkable educational tools on the open freeware market is bringing
 - a lot of benefits versus
 - a vast damage if used inappropriately
- ▣ Consequences on
 - changing learning scenarios
 - variety of students' expectations
 - new role of teachers

CHANGING LEARNING SCENARIOS

Development of symbolisation and presentation of mathematical contents using didactic tools

1. Improvisation – direct time demanding, slow presentation, limited possibilities to change examples, passive students

Black board + chalk, white board + pencil

2. Static period – direct/indirect time demanding for development of presentation materials, intuitive sporadic changes possible in ready made examples, passive students

Overhead projector + slides, other projections

CHANGING LEARNING SCENARIOS

3. Semi-static period – mostly indirect time demanding for development of programmes and presentations run by computer, one-man business, change in programme possible, passive students

Computers for presentations in computer labs, watching without touching

CHANGING LEARNING SCENARIOS

- 4. Semi-dynamic period** – direct/indirect time demanding for development of programmes and lecture presentations run by computer, leading students involved in running examples in labs, possible changes in the programmes necessary
Personal computers, data projectors, laptops
- 5. Dynamic period** – less direct/indirect time demanding, interactive approach of both teachers and students, presentations on-run, investigative modelling and simulations, heuristic methods
Dynamic (mathematical) software solutions

CHANGING LEARNING SCENARIOS

Diversification of teaching and learning environments caused by new didactic tools

- ▣ Direct environments
 - Contact hours
 - lectures, chalk and blackboard/dynamic visualizations on PC
 - practical exercises or labs, paper and pencil/work on PC
 - seminars and group discussions
 - personal consultations
 - examination

CHANGING LEARNING SCENARIOS

- ▣ Indirect environments
 - e-learning strategies upon teacher supervision
 - virtual classrooms and labs
 - organised distance learning
 - on-line courses with electronic communication
 - project based learning
 - materials-centred approach without teacher's interventions to the learning process
 - on-line assessment and exams

CHANGING LEARNING SCENARIOS

Students' expectations of teaching and learning differ from those of their teachers.

They might favour

- ▣ a-didactic strategies with available electronic instructional materials on-line, independent self-learning without teacher's interventions

contrary to the teacher's favourite

- ▣ transmissive way, following teachers working as researchers investigating new principles, discovering rules, and introducing new concepts properly based on results of the performed explorations

FOR AND AGAINST THE USE OF NEW TECHNOLOGY

„Good teaching may overcome a poor choice in the use of technology, but technology will never save poor teaching; usually it makes it worse.”

A. W. Bates: *Technology, Open Learning and Distance Education.*

- ▣ Teaching and learning in higher education is unlikely to be improved simply by the application of a new technology.
- ▣ ICT should be pedagogically integrated into the course design and adapted for the current environment.
- ▣ It can enable and support enhanced forms of learning.
- ▣ ICT use must be evaluated in the particular pedagogical context in order to understand how to use it effectively in future course designs.

ROLE OF TEACHERS

- ▣ Leading role of teachers as driving force of educational process is not suppressed
- ▣ rather it is even stressed by hypermedia usage

- ▣ **Teachers become designers of**
 - the content and its delivery
 - organisation of the direct contact educational hours in the classroom (lab or traditional)
 - ways of practising new material outside the regular educational process (e-learning)

ROLE OF TEACHERS

University teachers have a vital role to play in enabling students

- ▣ to challenge their existing intellectual potential
- ▣ to develop more appropriate practices for effective learning
- ▣ to improve analytical and synthetic reasoning
- ▣ to acquire a sustainable knowledge in the respective field
- ▣ to train abilities for practical applicability of acquired knowledge

ICT IN TEACHING GEOMETRY

- ▣ Scientific learning is difficult for students if they are just asked to memorize and recite facts to pass examinations.
- ▣ Understanding the tasks and difficulties emerging from their demanding and responsible role is far more fundamental to the success of a student than the use of ICT per se.
- ▣ In Geometry the effect of ICT can be of an utmost importance, as it can be
 - **builder**
 - **killer**
- ▣ **of geometric understanding.**

ICT IN TEACHING GEOMETRY

- ▣ Geometric understanding and spatial abilities are closely connected to imagination, creativity and independent imagery capabilities.
- ▣ Both physical and virtual models are useful.
- ▣ Manipulative hands-on techniques are helpful in developing cognitive connections (in dynamics).
- ▣ Passive watching of virtual models does not lead to conceptual understanding.
- ▣ Spatial abilities cannot be developed without proper mental operations.
- ▣ Mental models are crucial and inevitable.

EXAMPLES

- ▣ Experience acquired using ICT in teaching basic subjects: Mathematics I and II, Constructive geometry, Vector analysis
at the FME STU in Bratislava
- ▣ Mathematica, Maple, Matlab, Rhinoceros
- ▣ Dynamic mathematical software GeoGebra
- ▣ Examples of developed instructional materials, construction applets for interactive geometric modelling and short descriptions of basic concept backgrounds with geometric interpretations

Many thanks

for Your kind attention!