Designing Tasks for CAS/DGS Classrooms

TIME2010, Malaga, July 9th, 2010

DESIGNING TASKS FOR CAS/DGS CLASSROOMS

Matija Lokar,

Matija.Lokar@fmf.uni-lj.si

Univerza *v Ljubljani*
Fakulteta za *matematiko in fiziko*

Changes in the society

- Industrial Age → Information Age
- Major influence on educational systems
  - Some interesting data: Project Tomorrow (http://www.tomorrow.org)
    - Creating our Future: Students Speak Up about their Vision for 21st Century Learning, Project Tomorrow (2010)
- Informatization
  - Of the teaching process
  - Of everyday life:
    - Students (learners) - "Net (digital) natives"
    - your students are probably **not** DN yet, but ...
- Requirement for individualization

Individualization

- We live in a society, where everything is individualized and personalized:
  - we personalize our cell phones with ringtones, wallpapers, and skins
  - Experience in buying a bycycle …
- What about the resources used for teaching?

Individualization

- Not all students are able to learn successfully
  - at the same pace
  - with the same approach,
  - in the same environment,
  - following the same path,
  - in the same style and manner.
- Research confirms that every individual assimilates information according to their own unique learning style, need, and interest.
- Learning styles vary.

Individualization

- Challenge for the teacher:
  - Concretize educational content and adapt it to the interests and capability of students
- And of course
  - With appopriate usage of technology in mind

Usage of techology

- Substantial research done on appropriate usage
- If we want very short summary
- Two sentences from
  - Teaching Matters: A handbook for UTS academic staff, University of Technology, Sydney, Institute for Interactive Media and Learning,

- "New technologies should be used in the most appropriate way to provide a quality learning experience for students. "

The most appropriate

"The **most effective** kind of learning experience is determined not by the technology available, but by considering what is **most appropriate** for the students, the subject and the learning objectives and then selecting **the most appropriate technology** to use, be it a book, an online discussion, a multimedia simulation, or a workplace experience."

Main challenges

- Appropriate usage of technology
- Personalitization and customization

- Different role of teachers
- Different ways to prepare the resources

ARE THE RESOURCES PREPARED ACCORDING TO THESE NEW REQUIREMENTS THE TEACHER IS FACING?

Whole process

- When designing and evaluating CAS/DGS tasks, we should envision the whole process of their design, usage and modification. A view on a specific task namely changes according to a specific didactical situation.
- CAME06 (Belgrade 2009)
  - **Margot Berger: Designing Tasks For CAS Classrooms: Challenges And Opportunities For Teachers And Researchers**
  - She used semiotic framework to deconstruct CAS–based task into three key components.
  - To illustrate how framework illuminates aspects of the task design that may promote or hinder mathematical activity.

Margot's talk

- *Determine the values of x for which the quadratic approximation p(x) found previously is accurate to f(x) within 0.1. [Hint: Graph the functions, f(x) = Cos x, p(x), y1 = Cos x + 0.1 and y2 = Cos x − 0.1 on a common screen.]*

- Task may have better achieved its intended aim - regarding notion of an approximating polynomial - had I explicitly suggested a reasonable window.
- In pedagogical contexts where students are better rehearsed in using CAS, such an explicit instruction may not be necessary.
- This example illustrates how a small change in the task design may have powerful implications for the quality of the learning that may result.

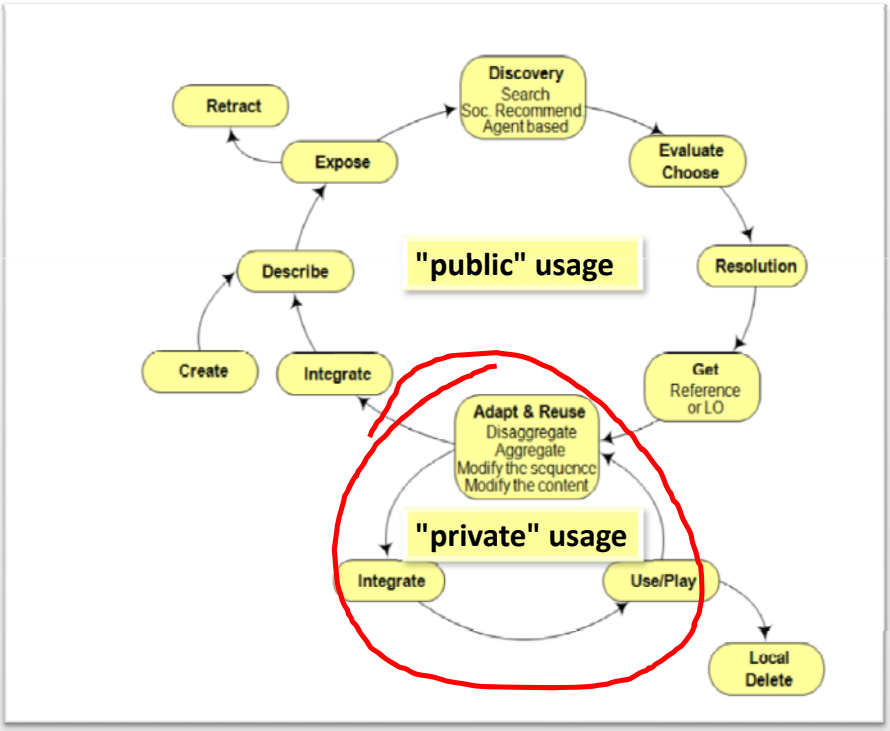
Consideration

- Specific pedagogical situation, particular group of students
- With another group – different analysis, different empistemic value, different ...
- Instead of **speculating** the precise **ratio** of both the procedural and the conceptual approach to make the task **suitable for all** students:
- Tasks should be designed in such a way that this **ratio** can easily be **adapted** to the **needs of the user**, be it a teacher or a student.

I use it myself

- But ...
  - Different class, different situation ...
  - How often do you use the same resource twice without modifications?
- So we often wear different hats
  - developer of the resource
  - user of the resource
- Even if we use resources by ourselves

The “life cycle” of a resource



Frans Van Assche, Riina Vuorikari, (2006). A Framework for Quality of Learning Resources. In U. Ehlers & J.M. Pawlowski (eds.), *European Handbook for Quality and Standardization in E-Learning*

Usage of resource

- Majority (up to 95% or even more) of the use of e-resources
  - not by authors themselves
  - (unpublished EdReNe internal study)
- Hwang, D., EDUNET: The Core of Korea's Knowledge Bank, 2nd Strategic meeting EdReNe, Lisbon, June 2008
  - Resources teacher knows to be adaptable are more accepted and used
    - Although they are mostly not changed

Problems

- One size fits all
  - The resource suitable for all students
  - Adaptation of the resource according to particular learner's needs
- Choice of tools
  - perfect math environment, CAS with "all functions"
  - "cooperation of tools"
- Interactivity
  - What, why, when, how, ...

"One size fits all" syndrome

- To provide instructions, to design a CAS task "suitable for all students"
- Why not:
  - "sub-hints", proper navigation, "dynamic help"
  - exploiting possibilities technology gives
    - Lack of cooperation with CS experts (GUI ...)
- And again
  - Expandable / changeable by "actual providers to learners": teachers

Choice of tools

- Problems in design of CAS tasks could be seen in a different light if another tool was to be used.
  - Often in just a part of task completion
- Overcame the wish to stay within the same environment, the same program
- amazing tricks can be seen, features exploited in unusual ways … done in Derive, GeoGebra, Mathematica … or tricky instructions are provided
  - to stick with the same tool at any cost

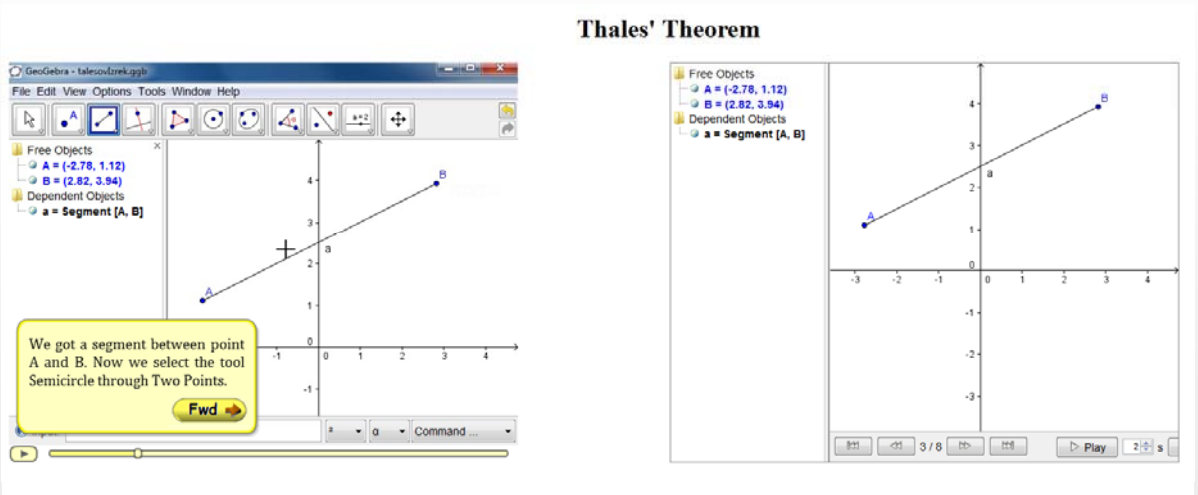
Choice of tools

- Part of the teaching process is also to teach students how to choose the most appropriate tools for the task
  - and “NetGeneration“ has no (or significantly less) problems with multitasking
- We should use different tools
  - One of the major aspect of the learning process
    - To choose the most appropriate tool
- Tools should “cooperate”

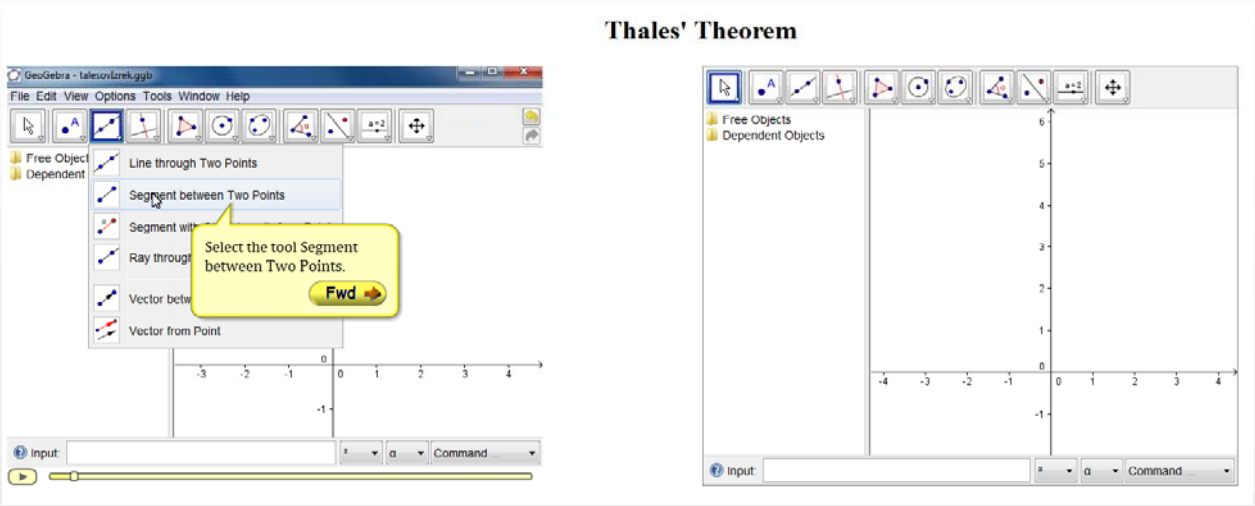
Design decisions

- Task – produce a resource explaining Thales' theorem
- Different models
  - Agreement: web page
  - GeoGebra as a tool
- Which one to choose?
- Which one is the most suitable?

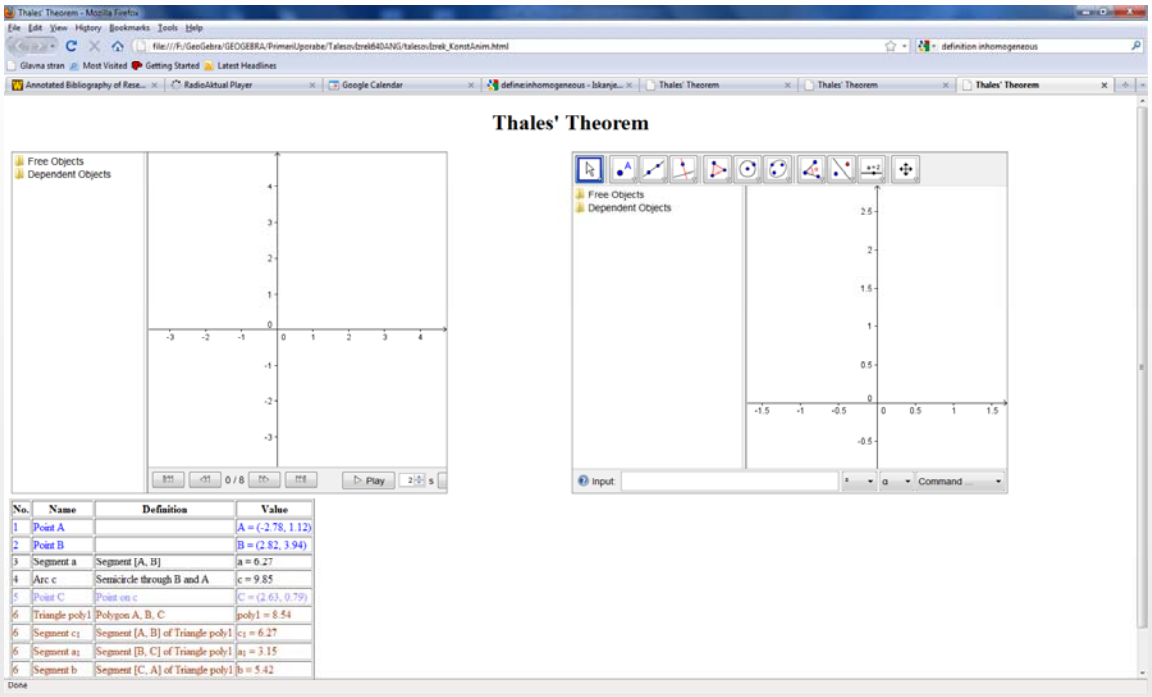
Video Instructions / Construction steps



Video Instructions / GeoGebra Applet



Construction steps with list steps/ GGA



Different tool

- Cabri Geometre or C. a. R. instead of GeoGebra

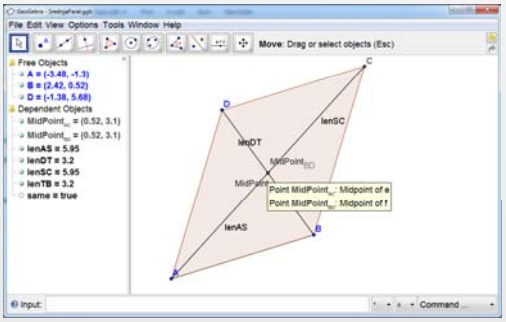
- Group of teachers polled
- No "first place"
- Votes dispersed among all possibilities
- Is it realy wise for the author to make a choice which **can not be changed**?

Added value

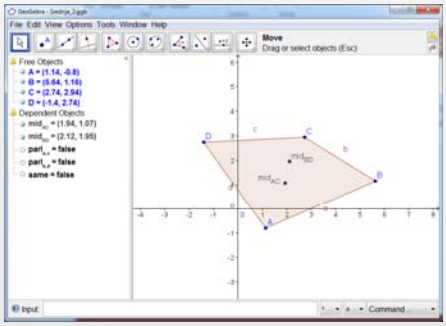
- Not just amplifying the "classical approach"
  - To easily demonstrate more case than in "paper and pencil envirnoment"
- New approaches are needed
- Consideration during design process
- Example:
  - Midpoints of diagonals of the paralelogram

Example

- Middlepoints of diagonals of parallelogram are the same point
  - Just showcase, same approach as in paper/pencil environment



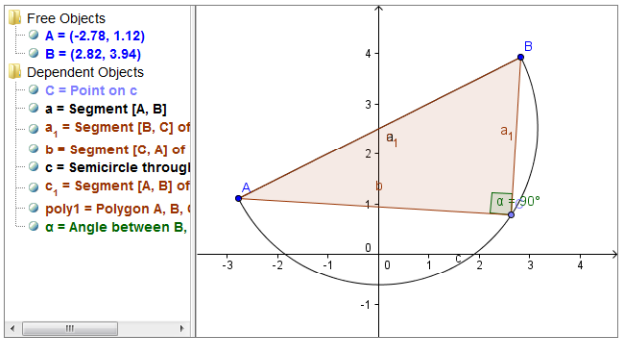
- If middlepoints of diagonals of convex quadrilateral are the same point → quadrilateral is parellelogram
  - "added value"



Possibility of changes

Thales' Theorem

Move the point C and watch if the angle between AC and BC changes.

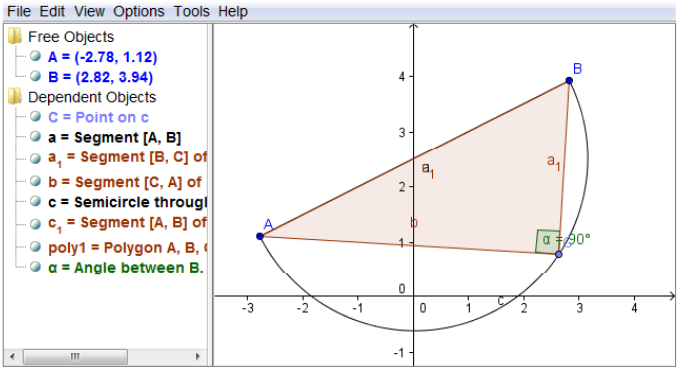


The point C is a point on arc C. We can move the point C only along the arc c.

Download ggb file

Thales' Theorem

Move the point C and watch if the angle between AC and BC changes.



The point C is a point on arc C. We can move the point C only along the arc c.

Difference?

Teacher

- is the one who must adapt the resource to concrete teaching situation and to a particular student
- So the teacher takes from the various resources and reorganizes and adapts author's ideas and models in his/her own way

Re-using resources

- Author creates the resources for an ideal situation, teacher teaches in “real world”
- Teacher should gain control over the resource
- Author should merely be an initiator of the resource in various forms
  - Teacher is the one who upgrades the idea, adapts it to a certain pedagogical situation, his/her beliefs, …
  - Teacher has the possibility to:
    - Adapt
    - Change
    - (Re)combine

The NAUK research group

- NAUK (advice / study)
  - **NA**predne **U**čne **K**ocke – NAUK
  - Advanced Learning Blocks

nauk.si
Napredne učne kocke

http://gradiva.nauk.si

E-LEARNING CONTENT SHOULD BE EASILY ADAPTABLE BY THE TEACHERS

Contacts

- Matija.Lokar@fmf.uni-lj.si

- http://www.nauk.si
- http://gradiva.nauk.si
- http://am.fmf.uni-lj.si

Gracias por su atención!