CADGME 2012

Faculty of Sciences, University of Novi Sad, Serbia

DGE Designed for Developing Concepts in Linear Algebra and Analytic Geometry

Ana Donevska Todorova

Humboldt-Universität zu Berlin

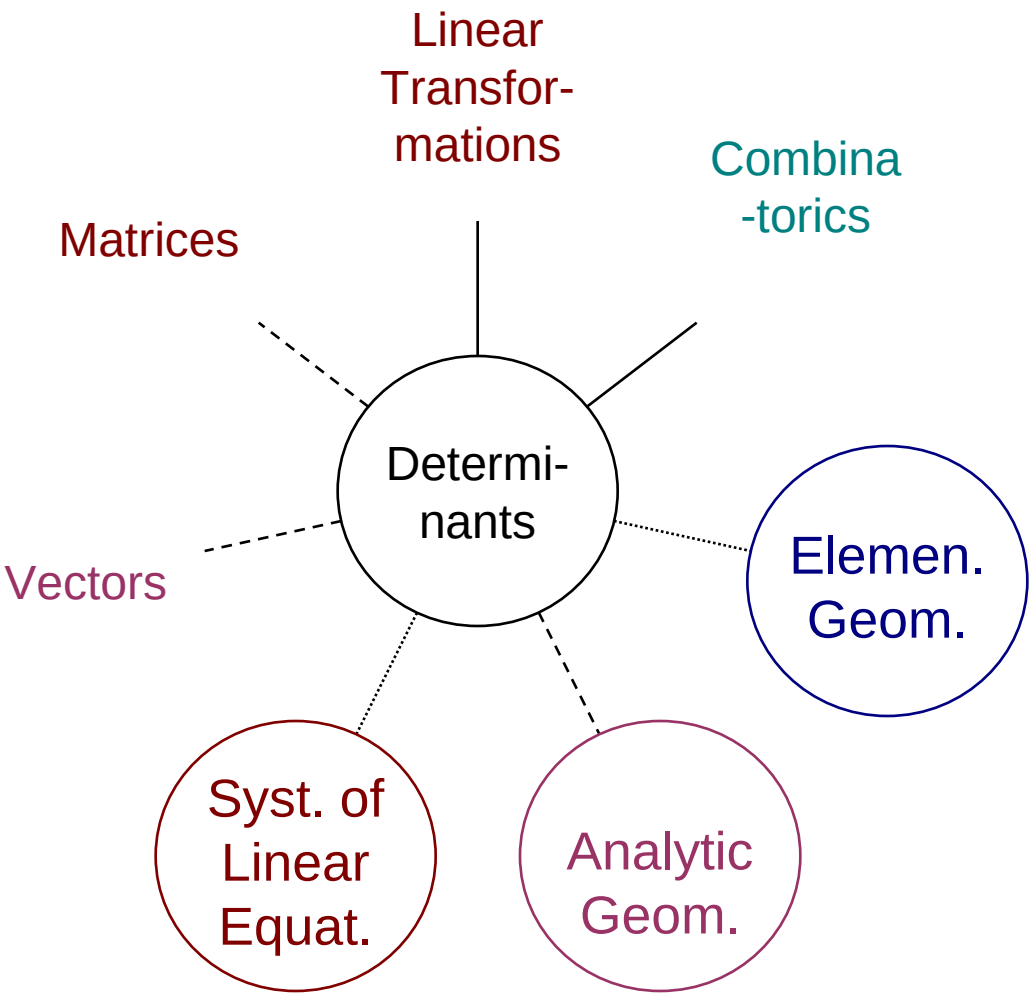
MIT University Skopje

Didactical Design

- Design of *learning environments;*
- *Teaching sequences* informed by close analysis of the specific topic of concern;
- *Framing* within a particular subject area.

- Ruthven, Laborde, Leach, Tiberghein (2009)

Teaching sequences



Concepts within Linear Algebra

Concepts in Geometry

Concepts in Combinatorics

Concepts in Analytic Geometry

.. Required Knowledge from Lower Level

-- Knowledge at the Secondary Level

– Knowledge at the University Level

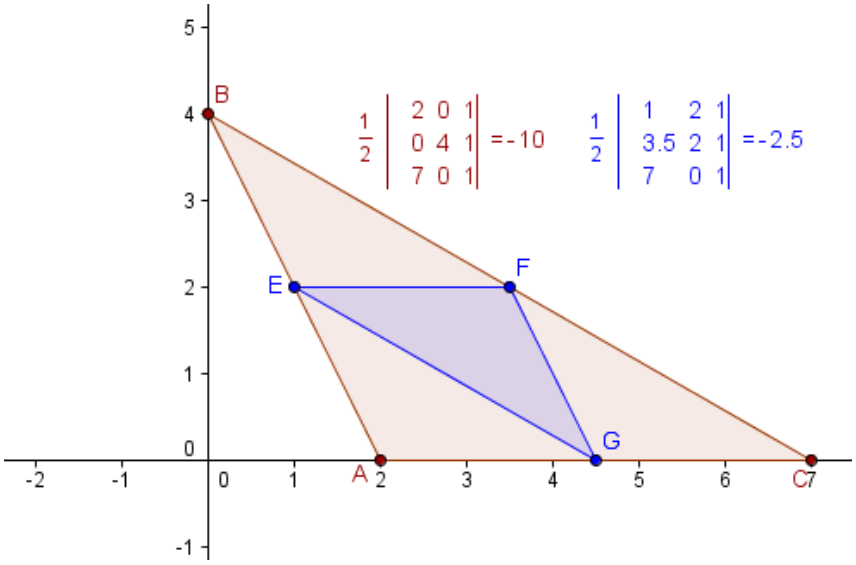
Figure 1. Connections between the Concept of a Determinant and Other Mathematical Concepts

*Donevska-Todorova A. (2012) Connections Between II and III Curricula for LA with Focus on the Concept of Determinants. Proposal with Technology Support, Conference Proceedings Gesellschaft für Didaktik der Mathematik, Marktbreit

Proposed Exercise 1 in the DGE

- Given the triangle *ABC* on the Figure. Let the points *E, F* and *G* be the mid points of the sides of the ΔABC .

  a) Find the ratio by exploring the Applet 1.
  b) Prove by geometric means and by determinants.
  c) Write your answer with algebraic notation in general terms.



Applet 1

*Gegeben ist das beliebige Dreieck durch $A(a,0), B(0,b), C(c,0)$. Sind *E, F, G* die Mitten der drei Dreieckseiten, dann bilden die Flächen der Dreieckeund das Verhätnis 4:1 oder -4:1. Bewiesen durch Rechnung! (Honsberg 1968, Aufgabe 8, p.18).

Proposed Exercise 2 in the DGS

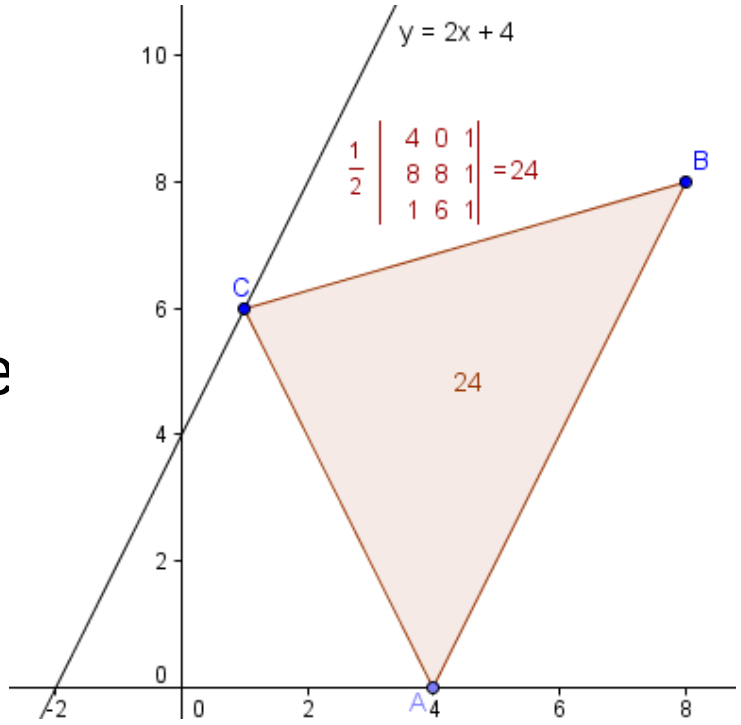
- The area of a given triangle is 24. Find the vertex *C*,

a) if $C \in y-axis$

b) if $C \in x-axis$

c) Which equation must all these vertices *C* satisfy?

d) What does the equation represent?



Applet 2

d) Auf welcher Linie liegen alle diese Punkte *C*? (Honsberg 1968, Aufgabe 9, p.18).

Solution of the Exercise 2 in the DGE

$$\begin{vmatrix} a & b & 1 \\ c & d & 1 \\ x & y & 1 \end{vmatrix} = 0 \qquad AB : y - b = \frac{d-b}{c-a}(x-a)$$

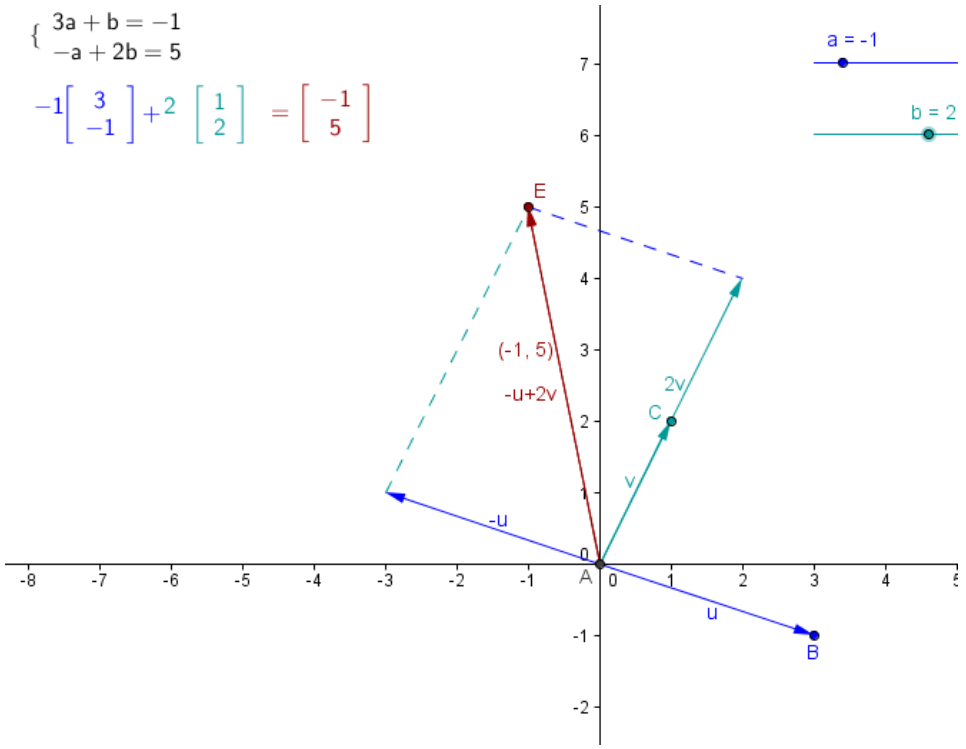
$$\frac{1}{2}\begin{vmatrix} 4 & 0 & 1 \\ 8 & 8 & 1 \\ x & y & 1 \end{vmatrix} = 24 \qquad y = 2x + 4$$

Proposed Exercise 3 in the DGE

- Solve the system of linear equations

$$\begin{cases} 3a + b = -1 \\ -a + 2b = 5 \end{cases}$$

using linear combinations of vectors.



Applet 3

Conclusions

- *The didactical situation is designed to the construction of some specific new knowledge by students, it must be experienced by students not as a matter of learning some ready-made result, but rather as one of resolving a genuinely problematic state of affairs with whatever knowledge they already have available*.*

- This DGE offers possibilities for students to explore, discover and connect different concepts as determinants, equations, triangles and lines

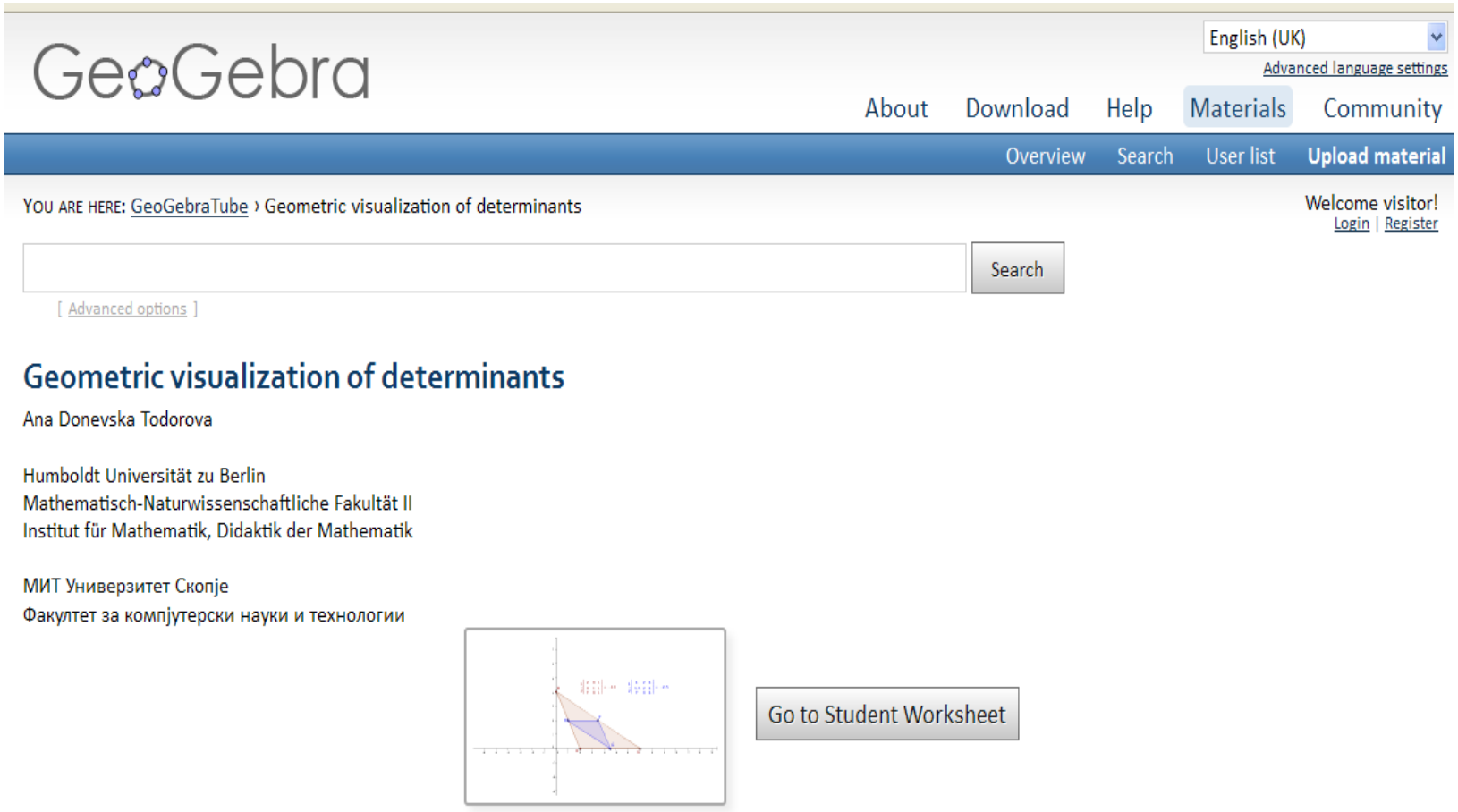
*Ruthven, Laborde, Leach, Tiberghein (2009).

Conclusions

- The proposed recourses are purposeful, easily modifiable, sharable, re-useable and they foster previous knowledge, collaboration and motivation among students.

  - http://www.geogebratube.org/search/results/uid/e0103bd541

GeoGebraTube



todorova@mathematik.hu-berlin.de