

Collaborative Aspects of the WGL Project

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CADGME 2012, 22–24 June 2012, Novi Sad, Serbia

Abstract

We intend to build a Web Geometry Laboratory (WGL) system that allows the teacher to create, store and provide a set of geometric constructions to its students.

The student are able to access the professor's constructions and download them into a personal *scrapbook*.

The groups of students are then able to work collaboratively, seeing and exchanging each other constructions.

The Web-based WGL environment aims to become a learning environment to be used during classes and also outside the classroom with DGS and GATP integration [Santos and Quaresma, 2012].

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Blended-Learning Web Environment

WGL – in the classroom

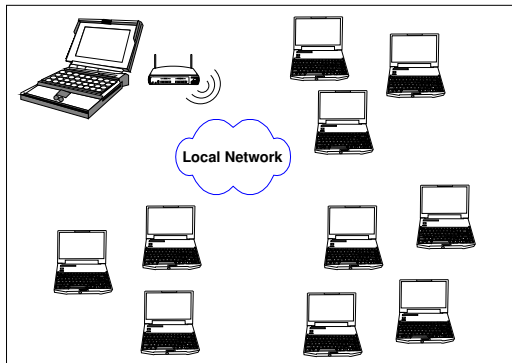
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Blended-learning
Web
environment

Adaptive
Environment
Collaborative

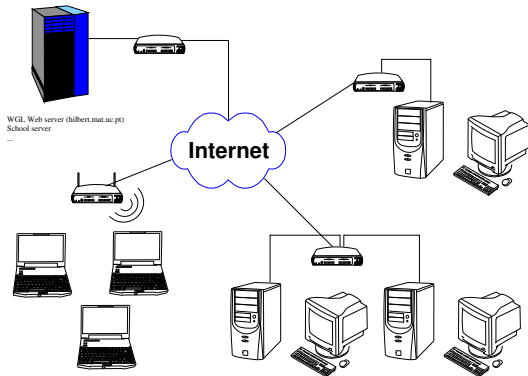
An example in Classroom

Bibliography



Blended-Learning Web Environment

WGL – outside the classroom



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It is intended that the student has continued support, or support in their homework.

Collaborative Learning

“Learning is a highly interactive and dynamic process.”
[Wang, 2010]

“Constructivism provides a theoretical framework for collaborative learning, where learners are put at the centre of the learning process to create their own knowledge through conversations.”
[Wei and Ismail, 2010]

Collaborative Learning

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Why collaborative learning?

- involves groups of students working to solve a problem or complete a task;
- students are working in groups, mutually searching for understanding, solutions or meanings;
- is a natural social act in which students talk among themselves;
- students help and encourage each other to learn, it involves a considerable interaction.

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In our case, the possibility for the student to exchange/merge their geometric constructions

WGL in Classroom

The geometry is being used as a means for describing, understand and interact with the space we live in being seen as the most intuitive part of mathematics, and related to concrete reality.

The dynamic geometry software allows the composition of geometric specification of free objects and objects obtained by construction using a set of steps that implement the basic constructions.

WGL in Classroom

Generic steps of the construction:

- 1 Choose the tool “Polygon” at the tool bar.
- 2 With the tool “Perpendicular Bisector” construct the bisectors of all sides of the triangle.
- 3 To find the intersection of perpendicular bisectors use the tool “Intersects two objects”.
- 4 To finalize the construction use the tool “Circle with Center through a Point”.

WGL in Classroom

We have the following example, which the teacher provides a triangle for the construction of circumcenter:

The screenshot displays the 'Laboratório de Geometria na Rede' interface. At the top, there are navigation icons and the title 'Laboratório de Geometria na Rede'. Below this is a menu bar with 'Forum / Help', 'Lista de construções', 'Bancada de trabalho', and 'Cessou a sessão'. A sidebar on the left contains 'Lista de Construções Geométricas' with a dropdown menu showing '20 - Triângulo_dado' and a search box 'escolha uma construção para trabalhar'. Below the sidebar is a 'Scrapbook' section with a 'Save' button, a text field for 'name (max 20 char)', and two 'Your scrapbook is empty' messages. The main workspace is titled 'GeoGebra Applet' and features a toolbar with various geometric tools. On the left, there are buttons for 'Atualize a construção:' and 'redefine a construção:'. The main workspace shows a triangle with vertices labeled A, B, and C. The coordinates for the vertices are listed as: A = (-1.5, 0.74) and B = (-2.06, 5.3).

Figure: Student View

The calculation of the point intersection of bisectors of a triangle.

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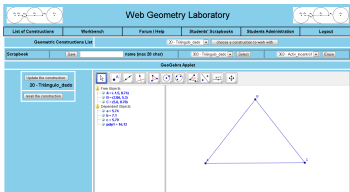


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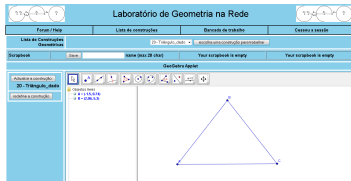


Figure: Student View

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WGL in Classroom

The teacher helps students with a additional comment at initial construction:

The screenshot displays the GeoGebra Applet interface within a web browser. The title bar reads "Laboratório de Geometria na Rede". The main menu includes "Forum / Help", "Lista de construções", "Bancada de trabalho", and "Cessou a sessão". Below the menu, there is a "Lista de Construções Geométricas" section with a dropdown menu showing "22 - Triângulo_dica_professora" and a button "escolha uma construção para trabalhar". The "Scrapbook" section shows "Save" and "name (max 20 char)" fields, with "Your scrapbook is empty" displayed twice. The main workspace is titled "GeoGebra Applet" and contains a toolbar with various geometric tools. On the left, a sidebar shows "Actualize a construção:" and "22 - Triângulo_dica_professora" with a "redefine a construção" button. The main workspace displays a triangle with vertices labeled A, B, and C. A "Dica:" (Tip) box on the right contains the text: "Para construir as mediatrizes de cada lado do triângulo, não se esqueça das construções realizadas na última aula..." (To construct the perpendicular bisectors of each side of the triangle, do not forget the constructions made in the last class...). The coordinate list on the left shows: "Objectos livres" (Free objects), "A = (-1,5, 0,74)", and "B = (2,06, 5,3)".

Figure: Triangle, teacher suggestion

WGL in Classroom

At this stage the teacher can access the constructions made by the students, as shown in the picture:

The screenshot displays the Web Geometry Laboratory (WGL) interface. At the top, the title "Web Geometry Laboratory" is centered. Below the title is a navigation bar with tabs: "List of Constructions", "Workbench", "Forum / Help", "Students' Scrapbooks", "Students Administration", and "Logout". The "Students' Scrapbooks" tab is active, showing a list of constructions. The selected construction is "385 - mediatrices".

The main workspace is titled "GeoGebra Applet". It features a toolbar with various geometric tools. On the left, there are buttons for "Update the construction" and "reset the construction". The central workspace shows a triangle with vertices A, B, and C. The medians are shown as blue lines, and the mediatrices are shown as red and green lines. The orthocenter is marked with a black dot.

The object list on the left side of the workspace shows the following objects:

- Free Objects
 - A = (-1.5, 0.74)
 - B = (2.06, 5.3)
 - C = (-5.6, 0.70)
- Dependent Objects
 - D = (2.05, 1.64)
 - a = 5.74
 - b = 7.1
 - c = 5.79
 - d: $-3.56x - 4.56y = -14.77$
 - e: $-3.54x + 4.52y = -0.10$
 - f: $-7.1x - 0.86y = -14.59$
 - poly1 = 10.12

Figure: Teacher can access the constructions made by the students – during the class

WGL in Classroom

The students have finished their construction.

The screenshot displays the Web Geometry Laboratory (WGL) interface. At the top, the title "Web Geometry Laboratory" is centered. Below the title is a navigation bar with tabs: "List of Constructions", "Werkbench", "Forum / Help", "Students' Scrapbooks", "Students Administration", and "Logout". A secondary bar contains a "Scrapbook" section with a "Save" button, a text input field containing "name (max 20 char)", a dropdown menu showing "386 - Circuncentro", a "Select" button, another dropdown menu showing "384 - mediatrices", and an "Erase" button. The main workspace is titled "GeoGebra Applet". On the left side of the applet, there are two buttons: "Update the construction." and "386 - Circuncentro", followed by a "reset the construction." button. The central workspace shows a geometric construction of a triangle with vertices A, B, and C. The circumcenter D is marked at the intersection of the perpendicular bisectors of the sides. The circumradius is labeled 'r', and the distance from the circumcenter to a vertex is labeled 'd'. The applet's object list on the left shows the following objects:

- Free Objects:
 - A = (1.5, 0.74)
 - B = (2.06, 5.3)
 - C = (5.6, 0.78)
- Dependent Objects:
 - D = (2.05, 1.04)
 - a = 5.74
 - b = 5.1
 - c = 5.79
 - e: $-3.56x - 4.56y = -14.77$
 - e: $-3.54x + 4.52y = 1.10$
 - e: $-2.71x - 0.08y = -14.59$
 - g (x: $2.05^2 + y: 1.64^2 = 13.38$)
 - poly1 = 16.12

Figure: Teacher can access the constructions made by the students – end of class

Conclusion & Future Work

WGL is a work-in-progress software:

Tasks implemented:

- Integration of a DGS (GeoGebra)
- Use of a geometric repository (individual/collective).

Tasks to do (yet to be completed):

- Collaborative Module — groups; users; fusion of constructions;
- Adaptative Module — capture the users interaction (geometric);
- GATPs Integration — using a GATP to validate a construction and/or prove a given conjecture.

prototype accessible at:

<http://hilbert.mat.uc.pt/WebGeometryLab/>

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