A Collaborative Laboratory for Geometry: A Case Study at Portugal and Serbia

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Web Geometry Laboratory (WGL)





Web Geometry Laboratory

The Web Geometry Laboratory:



Web Geometry Laboratory

The Web Geometry Laboratory:

• collaborative;



Web Geometry Laboratory

- collaborative;
- blended-learning Web-environment;



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Case Studies

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Web Geometry Laboratory

- collaborative;
- blended-learning Web-environment;
- dynamic geometry system;



Web Geometry Laboratory

- collaborative;
- blended-learning Web-environment;
- dynamic geometry system;
- personalised scrapbook of geometric constructions per user;



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- blended-learning Web-environment;
- dynamic geometry system;
- personalised scrapbook of geometric constructions per user;
- some adaptive features.



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Next step:



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Next step:

construction of student profiles and/or learning paths;



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- collaborative;
- blended-learning Web-environment;
- dynamic geometry system;
- personalised scrapbook of geometric constructions per user;
- some adaptive features.

Next step:

- construction of student profiles and/or learning paths;
- geometry automated theorem prover.



WGL Types of Users

Administrators creation of teacher-type users; access to log info; manage users in general.

Teachers access to the platform (DGS/repository of constructions); creation of students, groups, classes. Setting collaborative session;

Students access to the platform in individual work and in collaborative mode, sessions.



Collaborative Work in WGL

Planning a class the teacher has to:

- decide the groups and the students membership;
- prepare a set of geometric constructions: the starting points for tasks to be completed during the class; illustrative cases; etc.
 - Open Session name; Session Goal(s); Groups; Pre-defined constructions.
 - Start The students access to the platform change, from **normal** to **collaborative**.
 - End The students access to the platform change, from **collaborative** to **normal**.



Close Assessment and conclusion(s).

Student's Point of View



Student "Pedro" has the lock over the construction.

- Everything he does is echoed within his group (on the left).
- He can still work in his own construction (on the right).
- At any given moment he can release the lock.

Student's Point of View (cont.)



Student Maria does not have the lock over the construction.

• She sees the construction evolution as it is been done by *Pedro* (on the left).

• She can work in her own construction (on the right).

If released by Pedro, she can claim the lock.

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Adaptive Module

An adaptive module is an environment that is able to adapt:



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Case Studies

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• its behaviour to individual users based on information acquired about its user(s) and its environment;

• the learning path to the different users needs.



Adaptive Module

first task the collection of data, textual, navigation and also geometric data;

second task using the collected data, the construction of student profiles and learning paths.



Case Study at Serbia

Homeworks:



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Case Study at Serbia

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- force students to make more effort and devote additional time to double-check if they have understood and learned everything that they needed to learn during class;
- develop responsibilities and good work habits of students;
- motivated students to take active role in classes where homework material is analyzed since they have been working on that material themselves.







Two studies

• First study was 2013. (pilot study)



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Case Studies

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- One teacher, three classes. (about 67 students)
- Second study was 2014. (very detailed study)
- Two teachers, four classes. (about 92 students)
- In both studies topic was isometric transformation and student used WGL used for homework.





Experimental evaluation

• First study was pilot.



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- First study was pilot.
- The analysis results are based only on the arithmetic mean score.
- Second study was more detailed.
- We are precisely analyzed the results.




Experimental evaluation

• Each student could choose the method of doing homeworks (traditional way or using the WGL platform).



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Experimental evaluation

- Each student could choose the method of doing homeworks (traditional way or using the WGL platform).
- In first study 22 students used WGL, 45 traditional way to do homework.
- In second study 32 students used WGL, 59 traditional way to do homework.

Reason for this: Mainly due to technical problems or the lack of motivation to experiment with something alternative.





Experimental evaluation

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- All the time, in school they had only traditional teaching.
- Students who worked homework on traditional way they worked "pen and paper" homework.
- Students who used WGL for homework were organized in small groups and worked collaborative.



Results after pilot study

	1	2	3	4	5	mean
A11(WGL)	1	3	7	7	5	3.68
A14	4	6	8	2	2	2.63
A15	3	6	9	4	1	2.63

Figure : Results after pilot study



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Results of second study



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- We used the final grades of students from the previous semester.
- Students with better grades choose to use WGL (The average grade of 32 students that choose WGL was 3.16, while the average grade of 59 students that did not use WGL was 2.46.)



Results of second study



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- To test the significance of this difference we have applied Mann–Whitney–Wilcoxon non–parametric test (since grades were not distributed normally) and it showed that this difference is significant (U = 662, p=0.02).
- Students that used WGL had much better achievement (M=8.95 versus M=5.79 points). This difference is also significant (U=426, p=0.00). However, this difference can be attributed to the fact that WGL was used by students who are more interested in mathematics and had better prior achievements and no relevant conclusions about the contributions of WGL can be made from these results.



Results of second study



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Results of second study

• Therefore we excluded all the students with good prior achievements (most of them had good results on both test, whether or not they used WGL). After eliminating students with grades 4 and 5, 67 students remained, such that 18 of them used, and 49 of them did not use WGL.



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- The most important conclusion that can be drawn from our experiments is that in this population, students that used WGL had substantially better achievement (M=7.32 points in the group of 18 students that used WGL, versus M=5.26 in the group of 49 other students that did not use WGL). This difference is significant (U=236.5, p=0.00).





Conclusions

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• Our research shows that using all these features together gives encouraging results, but in our further work we want to quantify whether all these features are equally important.



Case Study at Portugal

A pilot study – Classroom.



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 - 2/3 tasks at classroom every students have 2/3 tasks (2 days).
 - 50 minutes colaborative work.

Case Study at Portugal

Brief results:

We performed a pre-test and post-test geometry, according to van Hiele, we used the Wilcoxon test (alpha=0.05) for data analysis (IBM SPSS Statistics 21), it was found that the scores be kept at levels 1, 3 and 4 from van Hiele, except level 2 (analysis), in which there was a significant improvement.



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Case Study at Portugal

Second Study

classroom and homework workshop with 16 secondary math teachers.

With this workshop it was intended to help teachers to include in their teaching practice the WGL platform providing a collaborative environment for geometry in their classrooms and it was done with 105 students.

In this workshop teachers played the roles of student and teacher at diferent times, performing collaborative tasks.



Preliminary Results

- the collaborative work mediated by technology, is not yet consolidated in the students.
- students showed some improvements in the area of geometry.
- WGL was very easy to use, after a short demonstration, by the students.



Future Work

• Finish the adaptive module;



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Future Work

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• Geometric Automatic Theorem Prover integration;


Case Studies

Future Work

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• Public server widely used.



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WGL Servers

The *WGL* public server (collaborative session):

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

You can enter as:

- cadgmeS/cadgmeS, student-level user (in a collaborative session)
- cadgmeT/cadgmeT, a teacher-level user.



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Thank you all for your attention

