

Collaborative GeoGebra for Virtual Math Teams

Gerry Stahl

The Math Forum @ Drexel University

www.mathforum.org

vmt.mathforum.org

Virtual Math Teams (VMT) Project

- VMT is a research project funded by NSF from 2003-2016.
- The general goal has been to support online collaborative learning of mathematics
- VMT software combines support for dynamic geometry with media for collaborative learning.
- The current goal is to refine a curriculum for group learning of the core concepts of dynamic geometry: dragging, constructing and designing dependencies

The VMT Collaboration Environment

- The VMT online environment includes components for students to work on and discuss math problems synchronously.
 - The VMT Lobby to find chat rooms on topics
 - GeoGebra tabs in chat rooms to do construction
 - Other tabs: whiteboard, help, web browser
 - The VMT wiki to share findings with other groups
 - The VMT replayer to review chat sessions
 - Logs of chat sessions and other visualizations

Multi-User GeoGebra

- Remote students can synchronously work on a shared construction together.
- Users can take turns manipulating the construction.
 - Adding, deleting, modifying and moving objects
- The construction will stay in sync on each user's screen.
- Users can chat about the problem as they work.

Two Students Construct a Perpendicular Bisector (video)

The image displays two side-by-side screenshots of a web browser window showing a chat interface for a GeoGebra activity. The browser tabs are labeled "demo4: tony (CID:1347034769142)" and "demo4: amantoan (CID:1347034769142)".

The main content area of the browser shows a task titled "Construction of a perpendicular at a point". The task instructions are as follows:

We want to construct a line GH perpendicular to line AB and passing through point C to intersect AB.

1. Clear anything on the drawing area with the menu "File" | "New" | "Don't Save".
2. Construct line AB with the Line tool. Construct an arbitrary point C with the Point tool not on line AB. Now you want to construct a perpendicular to line AB, which intersects line AB at point D.
3. Construct a circle with center at C using the Circle tool D not on AB). (passing through C).
4. Use the intersect tool to construct points E and F at the two intersections of the circle with line AB. Notice that points E and F are equidistant from point C.
5. Construct a second circle with center at E passing through F.
6. Construct a third circle with center at F passing through E (and therefore having the same radius as the previous circle).
7. Use the intersect tool to construct points G and H at the two intersections of the two circles with each other.
8. Construct line GH.

Use the angle tool for angle ACH to see if line GH is perpendicular (90°) to line AB at Point C.

Use the drag test to see if line GH stays perpendicular to line AB at point C.

Think about why GH is perpendicular to AB at point C. Was every step necessary? Can you simplify the construction?

Retrieved from "http://vmttest.mathforum.org/vmtwiki/index.php?title=Demo1_-_demo&oldid=100"

Categories:

- Demo1
- Demo
- Geometry

The chat window on the right shows the following messages:

amantoan
tony

tony leaves the room 12:33:19 PM EDT

8 tony joins the room 12:34:56 PM EDT

tony 12:36:11 PM EDT: Hello.

amantoan 12:36:15 PM EDT: Hi again.

tony 12:36:25 PM EDT: What is our assignment today?

amantoan 12:36:34 PM EDT: Let's look at the Task tab to see.

tony 12:36:59 PM EDT: We are going to create a perpendicular line based on Euclid's method

amantoan 12:37:13 PM EDT: Right.

amantoan 12:37:28 PM EDT: We will only use straight edge and compass like tools.

tony 12:37:39 PM EDT: Sounds fun.

amantoan 12:37:45 PM EDT: Let's get started.

tony 12:37:53 PM EDT: Ok, I'll start

2 minutes

Multiple GeoGebra Tabs

Topic 11 room_9: Gerry (CID:1374415275504)

File Edit Chat GeoGebra

Material: Triangles Squares Hexagons Add a tab +

File Edit View Options Tools Window Help

Move Graphics View
Drag graphics view or one axis (Shift + Drag)

Take turns dragging vertex A of triangle ABC and vertex D of triangle DEF.
Chat about dependencies you notice and what you wonder about this figure.
Construct a triangle inscribed in a triangle that behaves the same as this one.
Chat about how you are constructing and why.
It might be helpful to look at the other tabs for this topic and think about them together.

Take Control | nobody has control | Move Graphics View

Current users:
Gerry

Chat: (2)

Gerry 5:31:53 PM EDT: Hi team!
Gerry 5:32:20 PM EDT: Lets use Euclid's method to construct the outer triangle
Gerry 5:32:40 PM EDT: First I will drag the example triangle around
t Gerry 5:33:41 PM EDT: Now I will do what I said there

Message:
Do you see point I, the third vertex of my new triangle?

Support for Collaboration

- VMT is an online environment for students to work on and discuss math problems synchronously
- Main communication is through text chat
- Can point from a chat posting to other postings and to GeoGebra objects
- Students take turns controlling the construction and watching each other's GeoGebra actions

VMT Lobby with Topics

The screenshot shows a web browser window titled "List of All Rooms" at the URL vmt.mathforum.org/VMTLobby/commons/index.jsp. The page displays a navigation menu on the left with options like "New to VMT?", "List of All Rooms", "My Profile", "My Teammates", "My Rooms", "Messages", and "Manage Activities". Below the menu are links for "VMT Help Pages", "VMT Sandbox Room", "VMT Lounge Room", "VMT Wiki Pages", "VMT Replayer 3 Alpha-7", and "Logout".

The main content area is titled "View Chat Rooms as" and includes a "Math Subject Tree" and a "Tabular List" tab. A filter section allows users to "Filter Chat Rooms By..." with a dropdown menu currently set to "Test". There are "Apply filters" and "Use default" buttons.

The primary content is a list of topics under the heading "Dynamic Geometry (18 Topics)":

- ▶ **Topic 01** (9 Rooms, 0 Active)
- ▶ **Topic 02** (9 Rooms, 0 Active)
- ▶ **Topic 03** (9 Rooms, 0 Active)
- ▶ **Topic 04** (9 Rooms, 0 Active)
- ▶ **Topic 05** (9 Rooms, 0 Active)
- ▶ **Topic 06** (9 Rooms, 0 Active)
- ▶ **Topic 07** (9 Rooms, 0 Active)
- ▶ **Topic 08** (9 Rooms, 0 Active)
- ▶ **Topic 09** (9 Rooms, 0 Active)
- ▶ **Topic 10** (9 Rooms, 0 Active)
- ▼ **Topic 11** (9 Rooms, 0 Active)
 - ▶ **Topic 11 room 1**
 - ▶ **Topic 11 room 2**
 - ▶ **Topic 11 room 3**
 - ▶ **Topic 11 room 4**
 - ▶ **Topic 11 room 5**
 - ▶ **Topic 11 room 6**
 - ▶ **Topic 11 room 7**

- 4 Topic: Constructing Triangles
 - 4a Equilateral
 - 4b Where's Waldo?
 - 4c Exploring
- 5 Topic: Programming Custom Tools
 - 5a Bisector
 - 5b Perpendicular
 - 5c Parallel
 - 5d Right-Triangle
- 6 Topic: Finding Centers of Triangles
 - 6a Circumscribing
 - 6b Inscribing
 - 6c Near Sides
 - 6d Near Vertices
 - 6e Centroid
 - 6f Circumcenter
 - 6g Orthocenter
 - 6h Incenter
 - 6i Euler Segment
 - 6j Nine-Point
- 7 Topic: Transforming Triangles
 - 7a Transformations
 - 7b Symmetry
 - 7c Areas
- 8 Topic: Exploring Angles of Triangles
 - 8a Sum of Angles
 - 8b Polygon
 - 8c Corresponding
 - 8d Dilation
 - 8e Similar
 - 8f Sides
- 9 Topic: Visualizing Congruent Triangles
 - 9a Corresponding
 - 9b SSS
 - 9c SAS
 - 9d Combinations
 - 9e ASA
 - 9f SSA
- 10 Topic: Solving Geometry Problems
 - 10a Treasure Hunt
 - 10b Square and Circle
 - 10c Crossing an Angle
- 11 Topic: Inscribing Polygons

Supports for Student Reflection

- VMT chat rooms are persistent
- Students can always go back and see what their team did and then add to it
- Students can always scroll back in the chat
- Students can always scroll back in the history of a GeoGebra tab

VMT History Tracker In Action (Video)

The image displays two side-by-side screenshots of the GeoGebra VMT History Tracker interface. Both windows show the same geometry problem: a circle with center C and diameter AB. A point E lies on the circle, and a line segment CE is drawn. A point F lies on the diameter AB, and a line segment EF is drawn. A point D lies on the circle, and a line segment DF is drawn. A point G lies on the circle, and a line segment CG is drawn. A point H lies on the circle, and a line segment CH is drawn. A red line segment b is drawn through points C and G. A green box highlights the angle $\alpha = 90^\circ$ at point C. The interface includes a menu bar (File, Edit, View, Perspectives, Options, Tools, Window, Help), a toolbar, and a chat window on the right. The chat window shows a conversation between amantoan and tony. The left window shows the user 'nobody' has control, while the right window shows 'nobody' has control and 'tony is typing'.

Chat Log:

- amantoan 12:37:28 PM EDT: We will only use straight edge and compass like tools.
- tony 12:37:39 PM EDT: Sounds fun.
- amantoan 12:37:45 PM EDT: Let's get started.
- tony 12:37:53 PM EDT: Ok, I'll start
- amantoan 12:39:38 PM EDT: Let me try!
- tony 12:39:40 PM EDT: ok
- amantoan 12:40:23 PM EDT: I think that's it.
- tony 12:40:33 PM EDT: Let's check.
- tony 12:40:46 PM EDT: Looks good.
- amantoan 12:41:05 PM EDT: Yep
- tony 12:41:24 PM EDT: ok

1 minute

Supports for Teacher Assessment

- Teachers can enter any chat room - when students are there or any time later
- Teachers can scroll back in the chat and the GeoGebra construction
- Teachers can view the room Dashboard
- Teachers can download chat logs
- Teachers can view rooms in the replayer
- Other visualizations and analytics are currently under development

Teacher Dashboard

▼ Dynamic Geometry (9 Topics)

- ▶ **Topic 00: Warm-up** (9 Rooms, 0 Active)
- ▶ **Topic 01** (9 Rooms, 0 Active)
- ▶ **Topic 02** (9 Rooms, 0 Active)
- ▶ **Topic 03** (9 Rooms, 0 Active)
- ▶ **Topic 04** (9 Rooms, 0 Active)
- ▼ **Topic 05** (9 Rooms, 0 Active)

▶ **Group 1**

▼ **Group 2**

Username	# of Messages	Last Active
cheerios	56	Mar 4, 2013 16:12
cornflakes	41	Mar 4, 2013 16:12
emilyl	9	Mar 9, 2013 15:53
fruitloops	69	Mar 8, 2013 15:12
swampert	9	Mar 1, 2013 16:42

Add to Favorites

Save as JNO

View Chat Log

Get Log: columns for each user

Get Log: one column for all users

Get Log: Informatics

http://vmt.ma...mName=Group_2

Search or enter address

115	03/04/2013	15:36:55	15:37:01	read the instructions		
116	03/04/2013	15:37:28	15:38:45	how but how do we make the square?		
	03/04/2013	15:38:55	15:38:56	[fruitloops has fully erased the chat message]		
117	03/04/2013	15:39:10	15:39:11	a grid		
118	03/04/2013	15:38:57	15:39:11	like i know how to make the triangle but now the square		
119	03/04/2013	15:39:15	15:39:16	a grid		
120	03/04/2013	15:39:10	15:39:20	olets start by cinstructing a regular		

Chat Logs

	A	B	C	D	E	F	G	H
1	Line	Date	Start Time	Post Time	Duration	Event Type	User	
2	1	3/1/13		15:11:09	0:00:00	system	fruitloops	joins the room
3	2	3/1/13		15:11:50	0:00:41	system	cornflakes	joins the room
4	3	3/1/13	15:11:52	15:11:53	0:00:01	chat	fruitloops	heyyyyyyyyyyyyyy
5	4	3/1/13	15:13:04	15:13:05	0:00:01	chat	cornflakes	hi
6		3/1/13		15:13:26	0:00:21	Geogebra: Triangles	cornflakes	tool changed to Move
7	5	3/1/13	15:13:28	15:13:30	0:00:02	chat	cornflakes	i will go first
8		3/1/13		15:14:09	0:00:39	Geogebra: Triangles	cornflakes	updated Point A
9		3/1/13		15:14:20	0:00:11	Geogebra: Triangles	cornflakes	updated Point D
10		3/1/13		15:14:22	0:00:02	Geogebra: Triangles	cornflakes	tool changed to Move Graphics View
11		3/1/13		15:17:03	0:02:41	Geogebra: Triangles	fruitloops	tool changed to Move
12		3/1/13	15:17:22	15:17:22	0:00:00	Geogebra: Triangles	fruitloops	updated Point A
13	6	3/1/13		15:17:25	0:00:03	system	cheerios	joins the room
14		3/1/13		15:17:40	0:00:15	Geogebra: Triangles	fruitloops	updated Point D
15		3/1/13		15:17:43	0:00:03	Geogebra: Triangles	fruitloops	updated Point D
16		3/1/13		15:17:46	0:00:03	Geogebra: Triangles	fruitloops	tool changed to Move Graphics View
17	7	3/1/13	15:17:50	15:18:09	0:00:19	chat	fruitloops	when i move vertex a the whole triangle of abc moves
18	8	3/1/13	15:17:58	15:18:43	0:00:45	chat	cornflakes	when i moved point c the triangle stayed the same and either increased or decreased in size, but it was equivalent to the original triangle
19		3/1/13		15:18:09	0:0:34	Geogebra: Triangles	cheerios	tool changed to Move
20	9	3/1/13	15:18:14	15:18:52	0:00:38	chat	fruitloops	but when i tryed to move vertex d, it couldnt go behind triangle abc
		3/1/13		15:18:15	0:0:37	Geogebra: Triangles	cheerios	tool changed to Move Graphics View

Supports for Researcher Analysis

- Researchers can access all chat rooms, spreadsheet logs and replayer files
- They can download data from selected courses, teams, sessions, etc.
- The complete, detailed interaction is logged: chat postings, GeoGebra actions, VMT actions, etc.- for comprehensive analysis of group cognition

Curriculum and Chat Rooms

- Anyone can offer chat rooms, topics and GeoGebra tabs that they design
- Anyone can make new rooms and invite people to them

The VMT Lobby of Rooms (Video)

144.118.94.160:8080/VMTLobby/commons/index.jsp


The Math Forum @ Drexel
PEOPLE LEARNING MATH TOGETHER

Collaboration and Dynamic Mathematics in Middle and High School
Online professional development course offered Fall 2012 by the Math Forum, Drexel University, and Rutgers University (Graduate credit and stipends available)

Home Math Help Problems & Puzzles Math Talk Resources & Tools About The Math Forum
Welcome What's New Students Educators Parents & Citizens Researchers

Virtual Math Teams 3.0-Alpha-1

Welcome tony



- New to VMT?
- List of All Rooms
- My Profile
- My Teammates
- My Rooms
- Messages
- Manage Activities

[VMT Help Pages](#)
[VMT Sandbox Room](#)
[VMT Lounge Room](#)
[VMT Wiki Pages](#)
[VMT Replayer 3 Alpha-1](#)
[Logout](#)

View Chat Rooms as

Math Subject Tree **Tabular List**

Filter Chat Rooms By...

Project Last Activity
IGI 2012 Show All

Apply filters Use default filters

► **Geometry** (1 Topic)

Privacy Policy Terms of Use Collaborators Contribute Contact Us
© Drexel University 2010. All Rights Reserved.
The Math Forum is a research and educational enterprise of the [Goodwin College of Professional Studies](#).
[Collaborators](#) |

1 minute

Collaborative Dynamic Geometry Curriculum

- The VMT curriculum currently consists of:
 - 18 topics in dynamic geometry
 - 82 GeoGebra tabs (.ggb constructions)
- The teacher professional development course consists of the 18 topics (18 rooms)
- Teachers will then select 10 topics for students teams to work on (plus 1 intro and 1 wrap-up topic for students to work on individually)

Collaborative Dynamic Geometry Philosophy

- Dynamic dragging is an important way to discover the dependencies designed into a dynamic-geometry figure
- Dynamic construction is an important skill for designing dynamic-geometry figures
- Dynamic dependencies are important to understand in order to explain the behavior of dynamic-geometry figures
- Students should develop skills in
 - Dragging, constructing, custom tools, discussing dependencies, explaining proofs
 - These skills are more important than memorizing vocabulary or facts about geometry

Collaborative Dynamic Geometry Topics

- Philosophy in: “*Translating Euclid*”
- Topics: Dragging and the drag test; visualizing Thales and Pythagoras’ theorems; constructing equilateral, right and isosceles triangles; centers of triangles; transformations; angles; congruence and similarity; quadrilaterals; problem solving; proving with dependencies; special explorations

Collaborative Dynamic Geometry Professional Development

- Course for math teachers
- Sept 2 - December 15
- Requires 2 hours per week online with team
- Work on 18 GeoGebra topics

Collaborative Dynamic Geometry Professional Development

- Reflect on issues of mathematics learning and teaching: discourse and collaboration with & without teacher guidance, task design, justification and proof, and effective use of technology.
- Grad credit through Rutgers University or CEUs through the Math Forum at Drexel U.
- Stipends of \$500 or partial tuition reimbursement

Collaborative Dynamic Geometry SpringFest for Students

- Work in small teams of peers, organized by teacher
- Work on 10 sessions on GeoGebra topics
- Most collaborative teams win prizes
- Teachers earn stipend of \$1,000 or tuition reimbursement

For More Info

• padlet.com/wall/GGB2013-Session133

Tony Mantoan, VMT developer
Steve Weimar, dir. MathForum
Gerry Stahl, PI, VMT research

tony@mathforum.org
steve@mathforum.org
gerry@mathforum.org

padlet.com/wall/GGB2013-Session133

Most Visited Gmail Gerry Stahl's we... EM -- gerry

The Math Forum

Announces a course for math teachers:
COLLABORATIVE GeoGebra for credit or CEUs -- generous stipends available and prizes for your students!

Announcement of courses for math teachers on Collaborative Online GeoGebra
Registration open until August 15, 2013

In the coming school year, Rutgers University and The Math Forum will be offering a series of two courses for mathematics teachers highlighting collaborative GeoGebra for online small groups. The courses prepare teachers and their students to take full advantage of GeoGebra for gaining a deep understanding of basic geometric concepts and results by systematically learning about construction and the design of dependencies in GeoGebra. Teachers can earn graduate credit or CEUs.

The first course, starting September 2, will involve hands-on exploration of collaborative dynamic geometry using GeoGebra in the Virtual Math Teams collaboration environment. It will be conducted online and will include a series of geometry topics, which emphasize dynamic dragging, dynamic construction, design of dependencies, and collaborative problem solving. The set of topics is based on the approach to dynamic-geometry education developed in the forthcoming book, *Translating Euclid*, (see www.GerryStahl.net/dlibera/teuclid).

In the second course, fieldwork starting in mid-January, teachers will organize small groups of students to collaborate on a series of 10 of the same set of dynamic-geometry topics, either in class or after school.

Translating Euclid

A new book on transforming geometry education with GeoGebra.
Stresses the importance of teachers and students constructing relationships and dependencies in figures. Emphasizes collaborative learning in virtual math teams of students. Inexpensive e-book available now.

Translating Euclid
Designing a Human-Centered Mathematics

Gerry Stahl
David J. Utterson

Series Editor: John M. Carroll, Penn State University

Abstract:
Translating Euclid reports on an effort to transform geometry for students from a rote-and-copy-subject corpus of historical theorems to a stimulating computer-supported collaborative-learning inquiry experience.

The origin of geometry was a turning point in the pre-history of informatics, history, and rational thought. Yet, this triumph of human intellect became muddled through historic layers of systematization, beginning with Euclid's organization of the *Elements* of geometry. Often taught by memorization of procedures, theorems, and proofs, geometry is schooling rarely conveys its underlying mathematical excitement. The recent development of dynamic-geometry software offers an opportunity to translate the study of geometry into a contemporary vessel. However, this involves translation along multiple dimensions of the contextual and practical context of learning.

Translating Euclid steps through the multiple challenges involved in

MORGAN & CLAYPOOL PUBLISHERS

ISBN 9781627051354
Publication Date May 2013
List Price

- VMT server is available for all to use - <http://vmt.mathforum.org>
- Info on courses:
 - vmt.mathforum.org/vmt/announcement.htm
 - vmt.mathforum.org/vmt/course.htm
 - vmt.mathforum.org/vmt/stipend.htm
- Info on “*Translating Euclid*” book and topics:
 - www.GerryStahl.net/elibrary/euclid
 - www.GerryStahl.net/elibrary/topics