A Blended Mathematics Class

creating authentic online mathematical experiences and meaningful writing

what is an authentic mathematical experience?

an authentic mathematical experience is one where students are given opportunities to discover or construct the math that they are learning through scaffolded activities. some versions of this include relevant and real-world problem solving.

in this particular class, it is collaborating with peers, struggling, conjecturing, and proving those conjectures about the concepts, in their more “pure” form (without the use of contextualized, real-world problems).

what is a blended learning classroom?

a blended learning classroom is one where online/digital activities are implemented to facilitate more ways of understanding or more ways of "delivering" course content. it can provide opportunities for asynchronous, or different types of synchronous learning.

what is a Harkness math classroom?

a Harkness math classroom is one where students engage in solving problems each night and presenting their solutions to their peers each day, which in turn, elicits discussion about the mathematics that they are discovering. the teacher acts as the facilitator of the discussion, rather than the provider and lecturer of course content.

so, what does the online portion of a blended Harkness math class look like?

a blended Harkness classroom must involve discussion and problem solving, since this is the heart and soul of the face-to-face Harkness class. so, the online activities must involve discussion and collaboration about math problems. and, the problems must be conveyed in a digital format.

what kinds of questions do you ask for the blended component?

the problem set problems are relatively traditional--a lot of the typical proofs and applied algebra problems that you see in a regular geometry textbook.

i do not ask the same sorts of questions that i do in the problem sets. rather, i write applets in Geogebra that are geared toward providing students with an opportunity to visualize and explore the concepts, and to understand, on a deeper level, the meaning of the words we use in mathematics and the implications/applications of these words.

how?

i break students up into small groups, and i give each group a Google Doc, where they can freely talk to each other and share screenshots of the diagrams that they construct in the Geogebra applet.

conversations are completely synchronous, so that the discussions are dynamic, and are not hampered by time delay.

i play “big brother” and watch the discussions happen on my screen, and interject from time to time.

a pile of points

students are charged with constructing an understanding of the meaning of the word “equidistance”, while discovering the perpendicular bisector.

equidistance in relation to two points

A collection of points is given in a pile to the left. Drag the points so that each point is equidistant to A and B. Distribute the points so that they, as a collection, are spanning across a wide region.

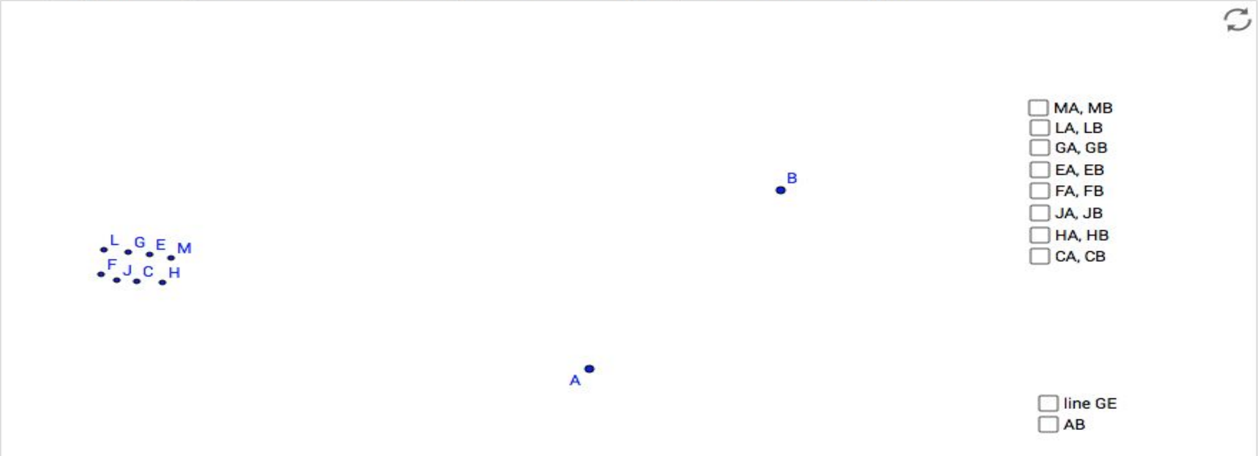
Discuss any and all observations you have with your group.

Now click a couple of the boxes to the right that are labeled with pairs of segments to help visualize the distances from each point that you dragged to A and B.

Unclick the boxes you clicked.

Now, click the boxes for line GE and segment AB. Discuss any observations you have with your group.

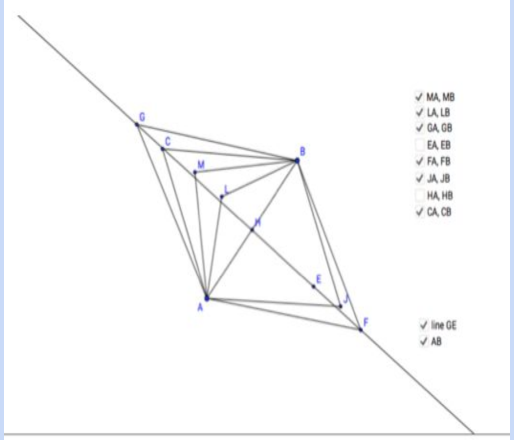
Can you pose a conjecture about the relationship between the dragged points and the static points A and B?



Here is the link to the applet

http://www.geogebra.org/material/simple/id/151520#material/196665

example 1 (honors class)



Segment AB is the base of an isosceles triangle formed by points A, B and the moving point (given that the moving points are equidistant from points A and B, thanks Gini).

^The triangle is only isosceles if the points are equidistant from AB

The moving point has to be on an imaginary line that bisects line segment AB in order for it to be equidistant from A and B - in this case, line GE

GE represents this imaginary line

I don't think that <AHB is an isosceles triangle because the points are collinear

So do the points always form isosceles triangles? We can't make that statement if there is an exception

-- good point - not always, because in this diagram (like Gini said) <AHB is a straight angle and therefore doesn't form a triangle

-I think that we have to make the point that they have to be noncollinear points (in order to form a triangle), because A, H, and B all lie on the same line

But, H is still equidistant from A and B

Yes, but it is not noncollinear, so it doesn't fit our said criteria

So: If a given point is noncollinear with A and B, and equidistant with A and B, then the triangle will be isosceles because a point equidistant from two other points forms an isosceles triangle?

-- sounds about right

-deal.

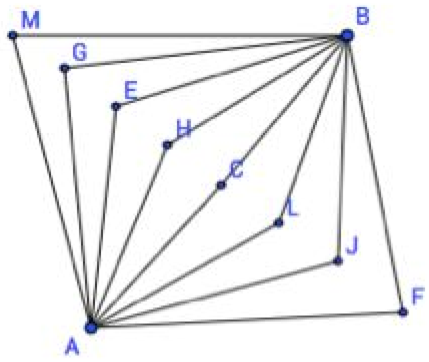
example 2, slide 1 (regular level)

students are grappling over the meaning of the word equidistance

(i write in black)

When I place points M-F in a straight line, and if that straight line is an equal distance between points A and B, then all points that are on that line are equidistant to A and B.

this is mine:

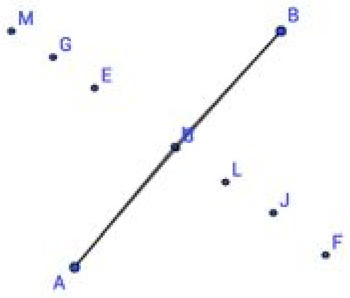


Thats really cool, but the points are not at an equidistant?

What needs to be equidistant in this case? We are asking for each point that we drag over to be equidistant to A and B.

example 2, slide 2

second student includes her diagram, and verifies with peers



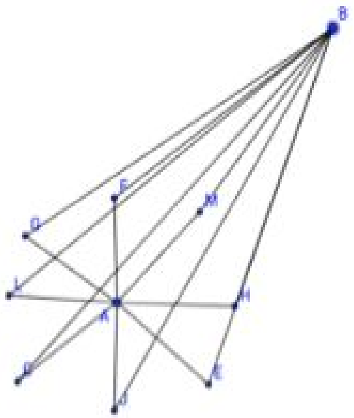
In this case^ wouldn't they be equidistant, for example point C, the distance of AC and CB seems to be equal is that what equidistance is?

Oh sorry I was wrong. I did not see that it was an equidistant from A to B.

example 2, slide 3

student may realize her diagram is wrong, but shows it to the group anyway, and i, and peers, quickly show how her diagram is incorrect.

Oh sorry I was wrong. I did not see that it was an equidistant from A to B.



This is what I have. Does anyone else have this too?

Are all of the dragged points equidistant to A and B here?

No, they are only equidistant from A, not B. Thats what i thought. Let me redo it.

what do students think?

students are split into two camps: they either find it too awkward and challenging and claim that they do not understand the point of them, or they find it fascinating and enjoy it.

those that like it say…

"I really like working out the problems on the google doc. It helps me with my proofs because I am essentially writing out a proof but in a discussion setting. It helps me make my thoughts condensed and clear, otherwise my peers will not understand me. I also have to think quickly and critically to contribute sufficiently to the conversation."

this is the *exact* intention of this activity!

what do students think? slide 2

those that dislike it say…

“The geogebra's do not make sense to me. I don't see how anything is discovered while doing this. I feel like it is repetitive and not helpful in any way. I don't understand them and they do not relate to the topic enough to be useful. “

While this opinion is maintained, 100% of the conversations are understandable and read like students achieve the intended learning goal. And, many students reference the Geogebra applets during regular discussions in class. This tells me that the activity is a legitimate struggle for some, and that some students interpret this struggle as “not learning.”

open discussion, questions and answers