Teaching Mathematics with Technology (TMT)

Video Transcript - Slider and input box pedagogical possibilities

Opening Webcam

Hello and welcome back to our series of video lessons for learning Geogebra. So far we have looked at the creation, labelling, formatting of simple geometric constructions using Geogebra, as well as in the use of a text box for describing the construction or computing values. We have also seen how to use the input bar for creating variables as well as creating new constructions. In this video, you will be exploring two features of Geogebra namely the slider and the input box which allow for the creation of dynamic interactive lessons which can be used in the classroom for enabling exploratory learning.

Slide 1

One of the powerful features of Geogebra is the ability to create dynamic constructions by changing the underlying parameters. There are two ways of doing this, one is through the use of a slider, where you can define the range of values that a parameter can take. The other way is through the use of an input box, where the user can define the inputs for a given parameter. These inputs can also be linked to the sliders. Together these two features allow for interactivity to be built into the lessons and when you can animate a construction it is possible to pause and allow for more exploratory discussions in the classroom as well.

Geogebra construction

We will start with this construction of a triangle with two given sides and an included angle, for our demonstration. I will first take you through all the steps of the construction, and then I will demonstrate each one of them in detail. So we have now drawn *segment AB* of a given length which is defined as *side1*. You will notice that an object has been created here. This is what we would call as a *slider*. We will then go on to creating an angle at *vertex A.* Defining the third side by marking the measure of the given included angle which we call *Base angle1*. Then we define the second side as well by drawing a circle centred at *point A*, of a given radius which we call *side2,* and the intersection of the circle and the *ray* that has defined the base angle will help us determine the third side as well. So now we have our required triangle.

Now I want to demonstrate how changing these parameters here through the use of these sliders, can actually change the triangle that we have constructed. Now we will look at each one of these steps of construction in detail, in this new Geogebra file. If you are following along with this video please open the Geogebra application on your computer.

We need three parameters to define this required triangle which is two given sides and an angle. We would need three sliders to define the range of values for these parameters as well. So I will start by *creating a slide*r. This is the *toolbar object* for creating a slider; we will click on this, and you click anywhere on the graphics view. I'm going to close the Algebra view now. So this opens up a box like this which has *the number, angle and integer, and the range of values* that each one of these sliders can take. So *the number* and *the integer slider* are the same in many aspects, except that the integer value- integer slider as the name suggests, can only take on integer values.

So we will define an integer slider, since we are looking at sides- side dimensions of a triangle; and I will call the slider- *side1.* It is always useful to give explanatory names for sliders because it will help us trace the construction later on. So you can give the range of values for your defined slider, as is meaningful for the construction that you will be working on. The *increment* is the change in the value of the parameter. So our slider has been defined. So we need one more slider for the *side2*. And we need another slider for the angle as well. So we should *check* the *angle box* here and again give an explanatory name for that, we will call it *Base angle1.* It cannot have a *minimum value of 0*, so you will define it, perhaps *100* and it also cannot have a maximum value of 3600, so we'll give it a meaningful maximum value which is called 1700.

Now you see that these objects are placed anywhere on the *graphics view.* You can move it around and position it neatly. For us to move it around, you click on the *move* object tool and *click on the object* and *drag* it. It is possible to move a created object as long as it is not *fixed* at a given position on the graphics view. The way we can find out if the object is fixed on the graphics view is- by *clicking on the object* and *right-clicking,* which is what I'm doing now, and it opens up a small window here, and you will see that the *fix object box* here has not been *checked.* If it is checked, notice that you can't move the sliders. So I will make sure that it is unchecked and I will move it. So I will do the same thing with the second slider for the *side2* as well as the slider for the angle.

So now we are ready to begin our triangle construction. So we need to draw the first segment which is the base or which is the *side1* of the triangle. So we will use a segment with a given length. I have plotted a point here but it opens up a box here called *length,* where it is waiting for you to define the parameter for the side length. Instead of giving a number which will define the length of the segment, you have to give the name of the slider that we would want to use to change the side of the triangle. So we call it *side1* here. So notice that I'm changing the value of this slider again by clicking on the *move* tool and moving this button on the slider across, I am changing the value of the segment with the given length that we have constructed for our triangle. So now we are ready to draw the angle at vertex A. Before that I will label the *segment as AB* and also move it around a little bit to make it neater, and we will go and define an *angle with a given size*. Start with the *leg point*, then *the vertex*, and then *enter the size,* and again instead of entering a value for the size of the angle, we must enter the name of the slider that we have created for defining the

angles. Now we notice that an angle of 45 degrees has been created rather than the point B has been rotated through the desired angle of 450. Now we will draw a ray to mark this angle that has been created as well. And then we are now ready to define the next side, we know how to do it, we would take an arc of a given length and place it at *point A*, centre it at *point A* and cut this ray that we have drawn and that will help us define the second side and the third side. So to draw an arc we will use the set of tools under this *circle option* here. You will see that there are many options for creating objects related to circles, we will choose a *circle with centre and radius*. I click on *point A* and we have to define the radius again. I will use the slider, so I can make it a little bigger so that it is visible more clearly so you see that this circle is increasing. And now we need to *plot the intersection of the circle* and the *ray* to define the second and the third side. So we will use the *intersect object* here and click on the *intersection point* that we would like to mark. So this marks the intersection point. We will label the *point of intersection* and use segment tools to join and define the *third side BC.* Now we would like to make this construction look a little neater, and we do not want to show the circle and the ray objects, etc.; so what we can do is to *hide* them from the graphics view. Please notice that if we delete it the construction disappears, the triangle disappears. So we cannot delete the object. So I'm going to do *Ctrl + Z* to bring it back, Ctrl + Z is the undo feature in Geogebra as well, like in other applications. I will click on the object that I do not want to display and *uncheck* the show object button and do the same here with the ray as well as with the rotated point. So now we can also join this segment, so we have our desired 3 segments which will define the triangle.

However, as we saw in an earlier video, this is not yet defined in Geogebra as a single object called a triangle. So for that, we will need to use this polygon tool and define the *triangle ABC* and back to this first vertex A, so that defines it as a triangle. So in the algebra view, you will notice that all the segments are being defined individually as well. As well as this *brown colour segment indicators* show that they have been defined as a polygon. This is important to do because otherwise, we will not be able to define measures related to the triangle like the area or perimeter. For instance, now I can use the *distance or length tool* and click on this object, it gives me the *perimeter of the triangle*. And I can also define the *area of the triangle* I needed to choose the *area tool*, we have it here; and so that gives you the area of the triangle. This is not possible to do if we had retained the construction only in the form of 3 segments and not defined it as a triangle. So we now defined the area and the perimeter of triangle ABC as well. So moving the sliders will change the triangle that we have created; we can either do it by *dragging* the button on each one of these sliders you can do it manually or in each of the sliders you can set up an option here called *animation* on which will automatically move the slider in one direction or in both directions or in reverse direction depending upon the demonstration that you would like to set up in the class.

Next, we will look at how to take an input and change the parameters of this triangle. An input that we take from the user will need to be linked to any given variable that has been defined for the parameter. So I go to *view algebra* and show you what are the objects that have been created. So

far we have all these three points have been created which are *A, B, and C* which indicates the vertices of the triangle, the polygon has been created, the segments have been created. This is a ray which is actually the angle that has been constructed which defines the angle that has been constructed. This is the circle that we constructed for defining the side. All the three sliders have also been created. Now if you want to create an object to which you need to link an input box we need to create another variable and I will call it *side1 new.* I'll give it a value let's say *7* right and close the algebra view for ease of display. And I'll also move this triangle around a little bit.

Now to create an input box we go to these set of tool options here and *check on the input box,* again you can click anywhere on the graphics view and it opens up a box like this; so give a meaningful name for the kind of input that this box is going to take, so we will say *take input for side1, and* we will link it to the object called *side1 new* that we have just created. Again you can move this around to wherever you decide. And I'll go and plot a point here and I will say *define a segment with given length* and I will use the variable which I have created called *side1 new,* instead of the slider.

Earlier we had created it with a slider and now using it as *side1 new* which is a new variable that we have created. Now we see that a new segment has been created with the value of *7 units.* So now if I change the input value notice that the segment length changes. Now it is also possible for us to link the input value and slider as well, so I will demonstrate that as well. So I will create another input box but what we do need to remember is that for linking it to any of each variable you need to have a separate input box. One input box cannot be linked to multiple variables. So we go here and take and create another input box. So I will define it as *take input for side2* and link it to the slider we have for the *side2*. Now notice that the value of the *input box* is completely filled with the *number three* which is the value of the slider. Now if I change it here, the slider value changes as well which also changes the original triangle that we have constructed. Notice that when we change the value of this *side 1* here, our original triangle does not because it is not linked to this slider which is *side1.* However, when I change it for the second input box it changes the first triangle as well because it is now linked to the slider that we created for the previous triangle. Now with this, we will also create another input box for the angle, and we will complete the construction.

This completes the second triangle as well. So now we will just change the inputs here to see how the triangle is changing. So we take *side1 8* and change the base angle to *750* and take input for *side2 as 6*. We notice that both the triangles are changing because we have linked the second and the third input boxes for the *side2* and the *base angle* to the sliders as well.

Ending slide

We will notice that this has a lot of possibilities for use in the classroom. For instance, in this example, we can allow students to see how the side opposite to a given angle changes when the angle is changed. It's also possible to demonstrate some special cases of triangles, and how in

certain cases it is not possible to construct a triangle. You can allow students to observe the changes in the values of the triangles and draw generalizations from that; and in effect, it creates a lot of possibilities for conversations around mathematical concepts in the classroom.

Closing Webcam

That brings us to the conclusion of this video on the creation of sliders and input boxes. Do check out the course page and practice the activities listed and make sure you practice all the features that we have introduced so far in this course. Look forward to seeing you in our next video on the use of checkboxes for creating and directing the flow of lessons in Geogebra. Thank you.