Grasp Meanings with Interactive Java Animation on WWW

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Abstract

We have developed a series of java applets with interactive animation for secondary and college level. Over 100 programs at our web site (http://www.ies.co.jp/math/java/iesjava.html-ssi)are in use on internet. The prime purpose of our project is to help students grasp meanings in mathematics.

Students often say "I don't understand the meaning." For those students, figures and diagrams are powerful aid to understand the meaning, and animation has still great potential since capable students and math teachers are usually good at operating the images in their mind. Using animation, teachers can realize their own vivid images on the screen. If students succeed to internalize the images of concepts, they will obtain the ability to operate in their mind, and they will be able to predict the rough result. In this paper, I will discuss the role of interactive animation with several examples at our web site.

Dynamic Manipulative

Animation is powerful for presenting the idea. But it has limitations since animation is one way stream and we can not change the story. Students need to touch, operate, manipulate and play with objects. We added interactivity to animation. Thanks to computers, it is possible to create dynamic manipulative on the screen.

For example, figure 1 is a screen shot of the applet for Pythagoras Theorem. Students manipulate the figure and transform the rectangles. Using this kind of applets, students get familiar with transformations and use similar method to solve other problems.

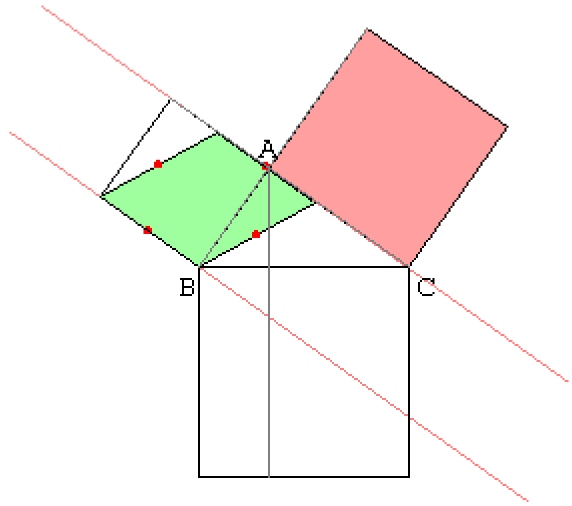

figure 1 Pythagoras Theorem

Conveying Images

Interactive animation conveys our image to students. We can transform figures on the screen and manipulate the images. If students obtain a good image and get familiar with it, they can apply it to similar situations. They will be able to operate the image in their mind and make rough predictions.

Figure 2. shows the animation of derivative of functions. Many Japanese high school students don't have the visual image of the relation between y=f(X) and y=f'(x).

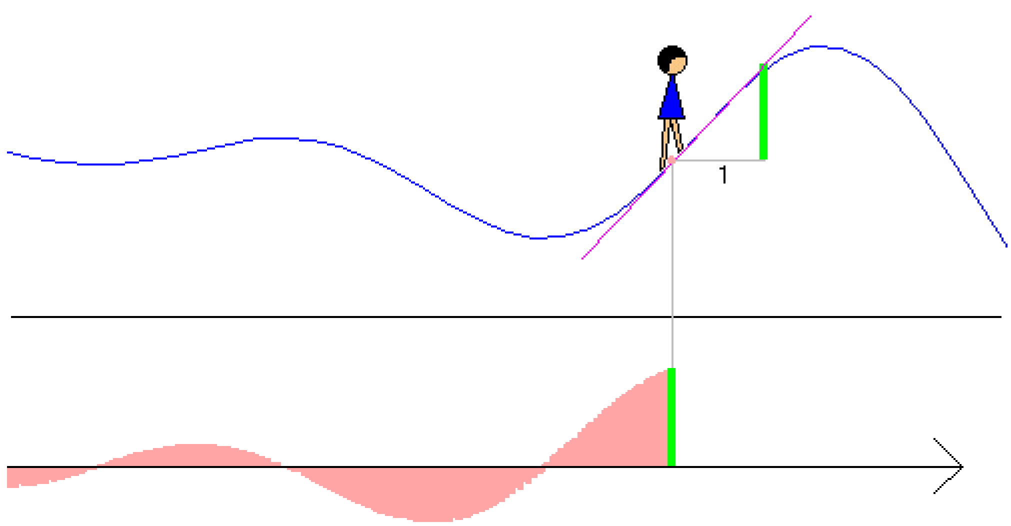

figure 2 Derivative

Figure 3 shows another image of derivative. It depicts the fundamental theorem of calculus. If students haven't understood the meaning of limit and division properly, the former image of slopes disturbs to accept differenciation of Area; S'(x).

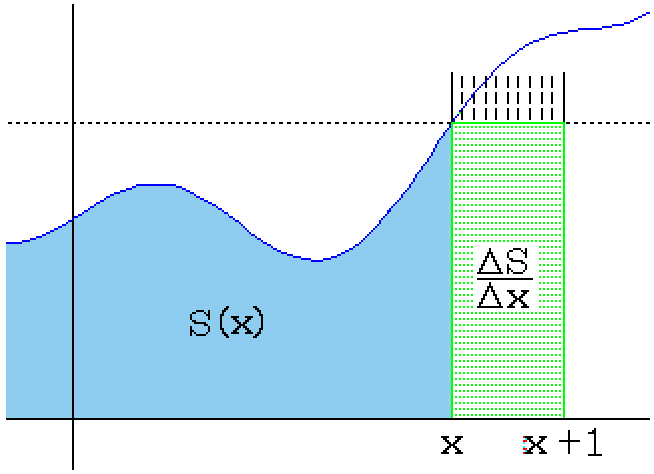

figure 3 Fundamental Theorem of Calculus

There are some examples related to the whole plane. The image resembles "fields" in space. If student grasp the structure of the field, it is easy to solve the following problems.

Figure 4 shows a problem of finding the maximum angle. It says "Find point P on line m such that angle APB becomes maximum." The picture in the right shows the image of plane filled with multiple circles.

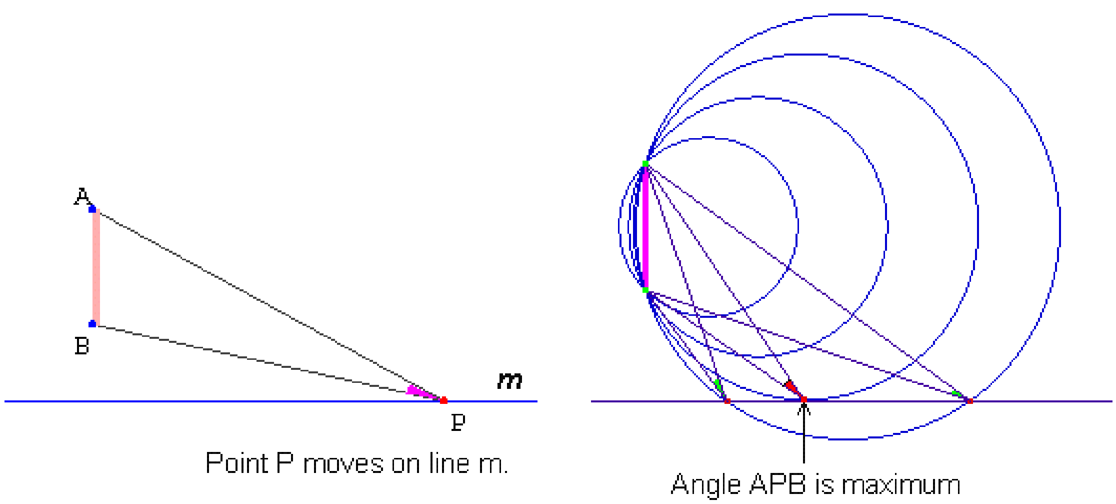

figure 4 Maximum angle

The rectangles in figure 5 represent dot product of two vectors. Vector OA is fixed. The area changes with the motion of vector OP. The problem asks "Find point P on circle C so that the dot product of OA and OP becomes maximum. The picture in the right is the image of the plane filled with lines perpendicular to OA.

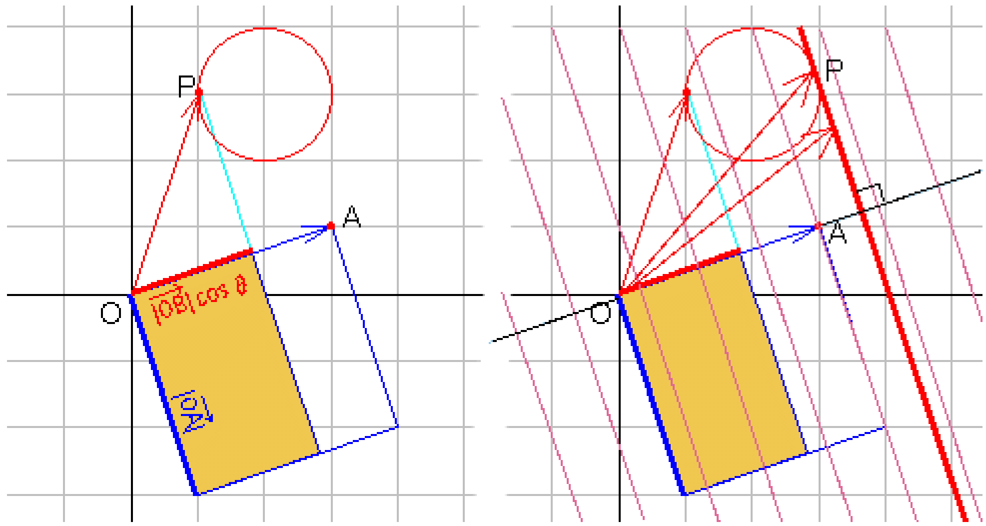

figure 5 Maximum value of dot product

Conclusions

1. Dynamic manipulatives are more flexible than real models. We can create imaginary manipulatives that is impossible in the real world. Every teacher has the opportunity to invent new manipulatives.
2. We need to find good images that is applicable to various problems. Those will become basic tools to grasp meanings.
3. It is not easy for students to understand moving figures even if the image is excellent. When we use interactive animation, we should be careful about other conditions such as our view point, unconscious premises, and students' level of knowledge.

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