Designing instructional tools by Flash MX ActionScript

some examples to teach basic geometric concepts

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It is believed that technology will transform how we view teaching, and it is not destined to serve simply as supplementary resources. Kent and McNergney (1998) argue that “Good ideas, not necessarily new technological developments, guide the way”. (p.50). Olive (1994) also suggested the consideration of supports embodied in the computer microworlds, so teachers can save time and apply them easily. The development of technology-based instructional tools should focus on the transition from concrete experience to abstract mathematical ideas, the exploration and discovery of new mathematical concepts, problem solving processes and the motivation of student learning. And moreover, they must be appropriate for teachers to present in class and with interactive characteristics so that students have the opportunity to feel the beauty of mathematics.

As we all know, Flash has been a useful tool to create animation pictures. However, integrating these functions into mathematical learning was little. With its strong functions, Flash MX ActionScript could be used to create highly interactive activities to motivate students’ mathematics learning. Based on the van Hiele theory and ICON principles, we developed a series of instructional tools on the web (http://163.25.178.88/lii/basicgeometry/index.html) to teach junior high school students basic geometric concepts. In this article, we will propose two instructional tools to help students explore exterior angles of polygons and interior angles of a triangle. Each instructional model includes a discussion of the object and designing ideas of the tool, questions to explore, an on line test, electronic tools, and media illustrations for the applications of the electronic tools.

Rationale to develop these electronic tools

Jonassen (2000) claims that the relationship between computer and learning are learning from computer, learning about computer, and learning with computer. What Jonassen called learning with computer is the stage of technology implementation. In this stage by his opinion, teachers use computers as “mindtools” to motivate students engage in critical and high level thinking. What roles should computer play are supporting knowledge construction, explorations, learning by doing, learning by conversing and learning by reflection. Based on this, three kinds of electric instruction tools can be developed; they are tools for presentation, for interaction, and for construction. But, how can Jonassen’s concept of mindtools be carried out in designing school mathematics learning activities? Black and McClintock (1996) proposed an interpretation construction design model (ICON) to design science instruction. This model includes eight designing principles for instruction. They are observations in authentic activities, interpretation construction, contextualizing prior knowledge, cognitive conflict, cognitive apprenticeship, collaboration, multiple interpretations and multiple manifestations. We consider these principles are also useful in designing mathematic learning activities. When talking about teaching of school geometry, van Hiele’s theory has been the most influential factor in geometry curriculum all over the world. The van Hielel couple also commended a five-stage teaching model to teach geometric concepts in school. The five teaching stages in this model include information, guided orientation, exploration, free orientation, and integration in sequence. We then integrate van Hiele five-stage learning model and ICON model to design mindtools to teach junior high school students basic geometric concepts.

An example shows the design of “exploring sum of exterior angles of a triangle” will be discussed in detail as following:

Van Hielel five-stage teaching model	ICON model	Main activity
Information	Contextualizing prior knowledge.	A thief run away from point P on a triangle park but was caught by a policeman on point Q. If $\angle A = 60^\circ$, what is the angle size the thief turn from P to Q?

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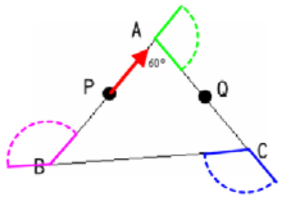
<tr><td></td><td></td><td>
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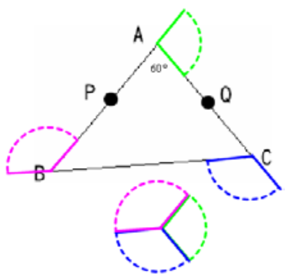
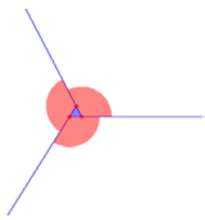
<tr><td>Guided orientation</td><td>Observations in authentic activities, cognitive conflict, and cognitive apprenticeship.</td><td>Introduce the concepts of interior angles and exterior angles of a triangle.</td></tr>
<tr><td>Guided orientation and exploration</td><td>Interpretation construction and multiple interpretations.</td><td>Posing question: Ask students to guess what is the sum of three exterior angles of a triangle? And encourage students to guess the answer. (Student activity) Based on students’ discussion results, teacher can propose different strategies to solve the problem. They represent multiple interpretations to help students construct the concept.
Strategy 1:


Strategy 2:
</td></tr>
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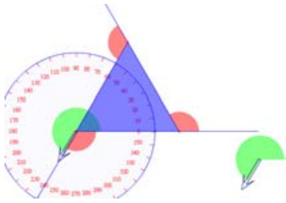
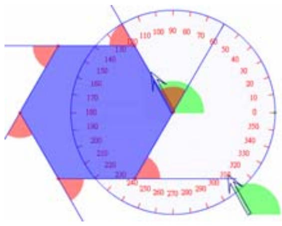
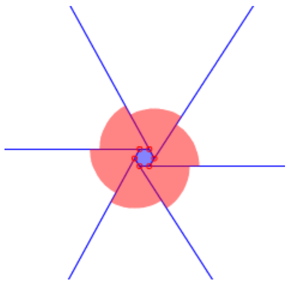
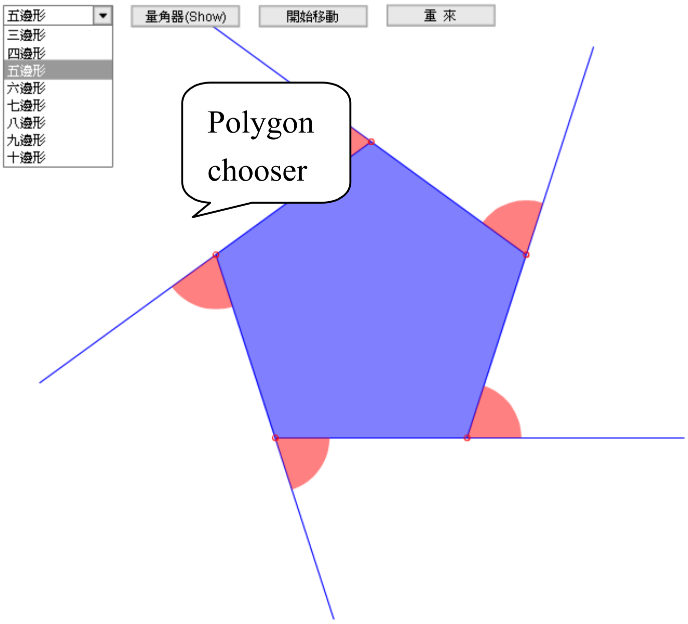
		Strategy 3: 
Free exploration	Collaboration, multiple interpretations and multiple manifestations.	Posing questions: What is the sum of the exterior angles of a quadrilateral, or a pentagon, or a hexagon? Students can collaborate with each other to explore the question and verify their answers from the computer.  
Integration	Collaboration, multiple interpretations and multiple manifestations.	Students present their findings and discuss them in class. Teacher can have an integrating discussion with students.

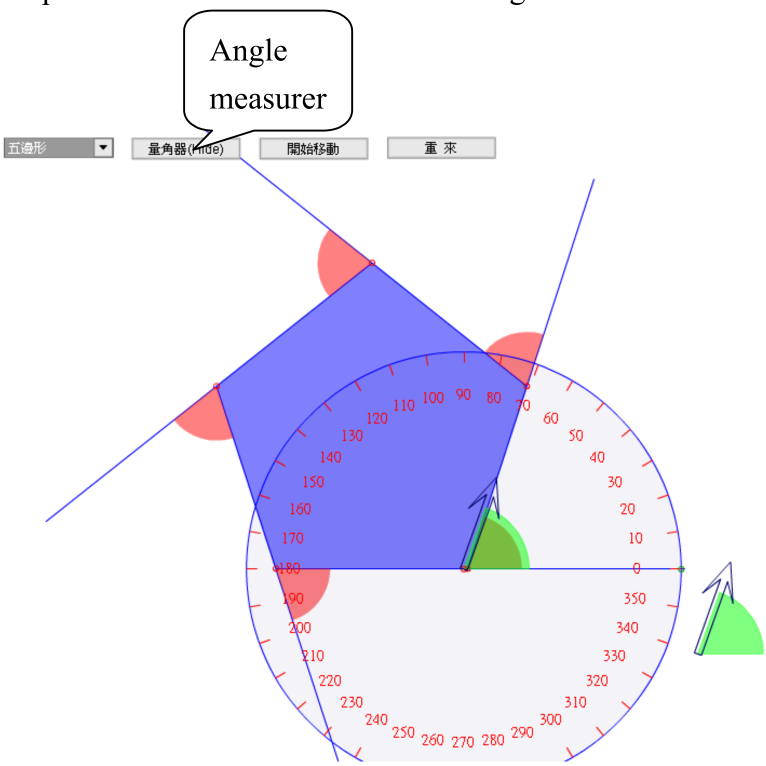
Introduction of the electronic tools

1. Exploring exterior angles of polygons

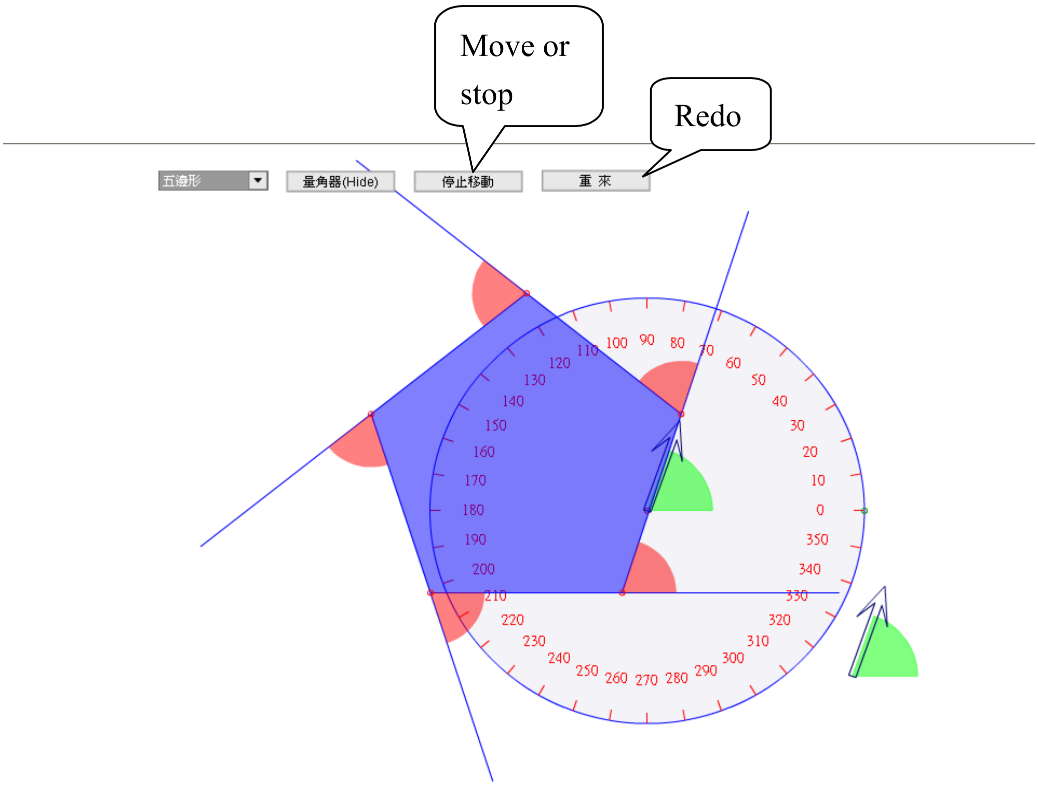
Step1: Choose any polygon from the menu



Step2: Use a protractor to measure the exterior angles

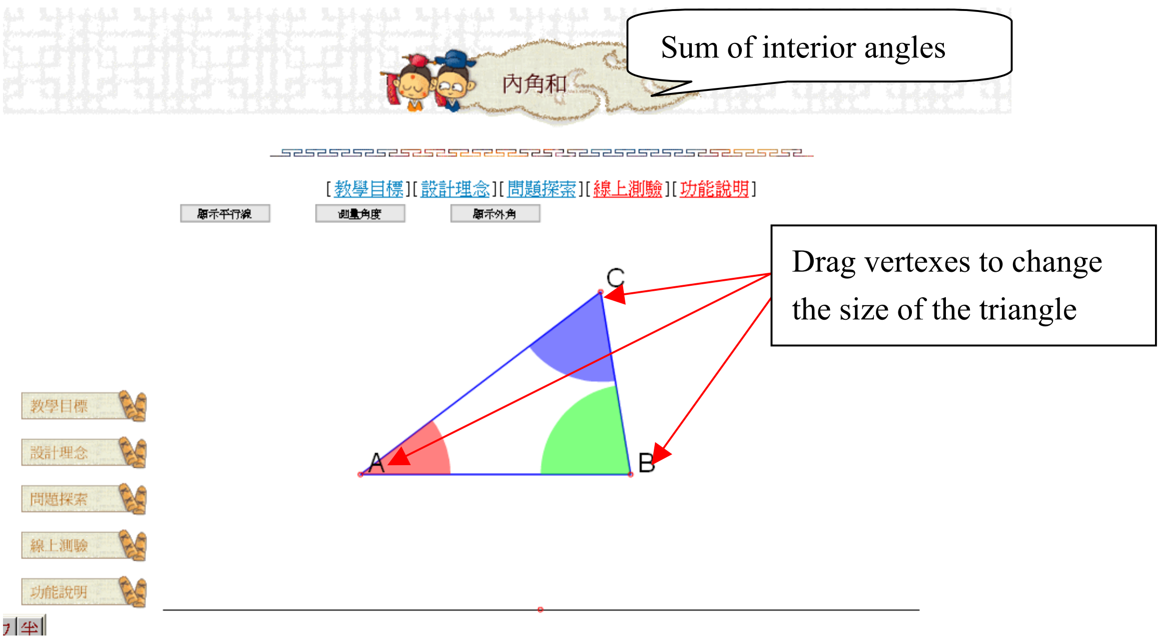


Step3: Open the move function to move the protractor to each vertex

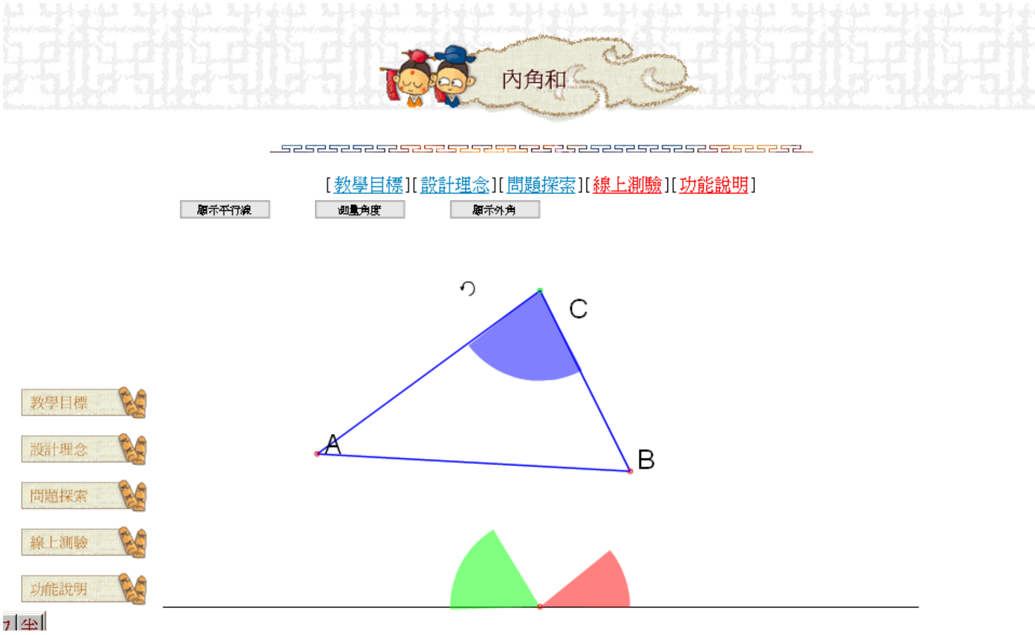


2. Exploring sum of the interior angles of a triangle

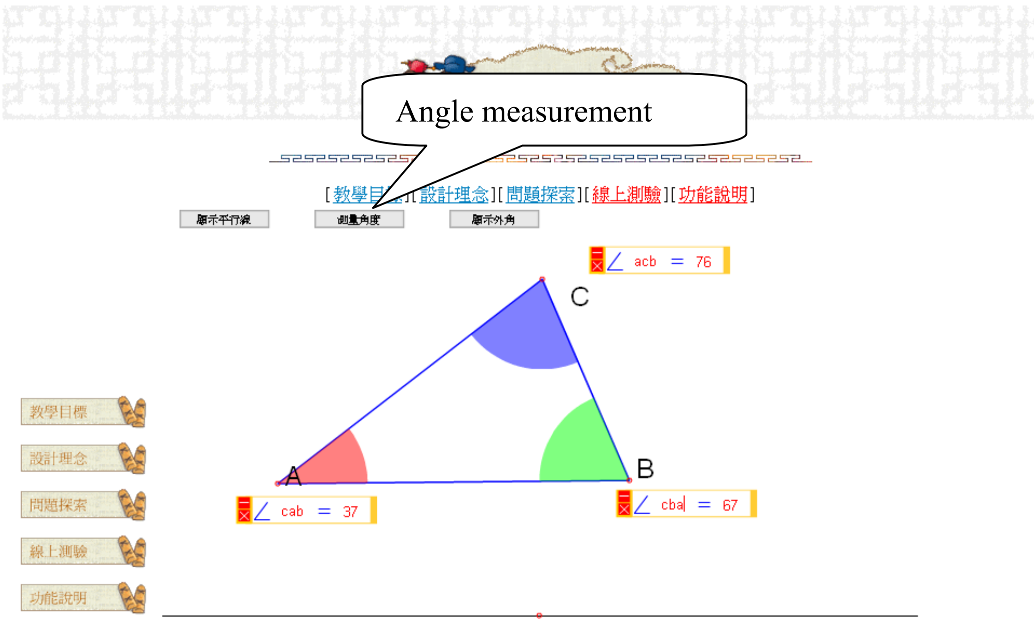
Step1: Drag vertexes to change the size of the triangle.



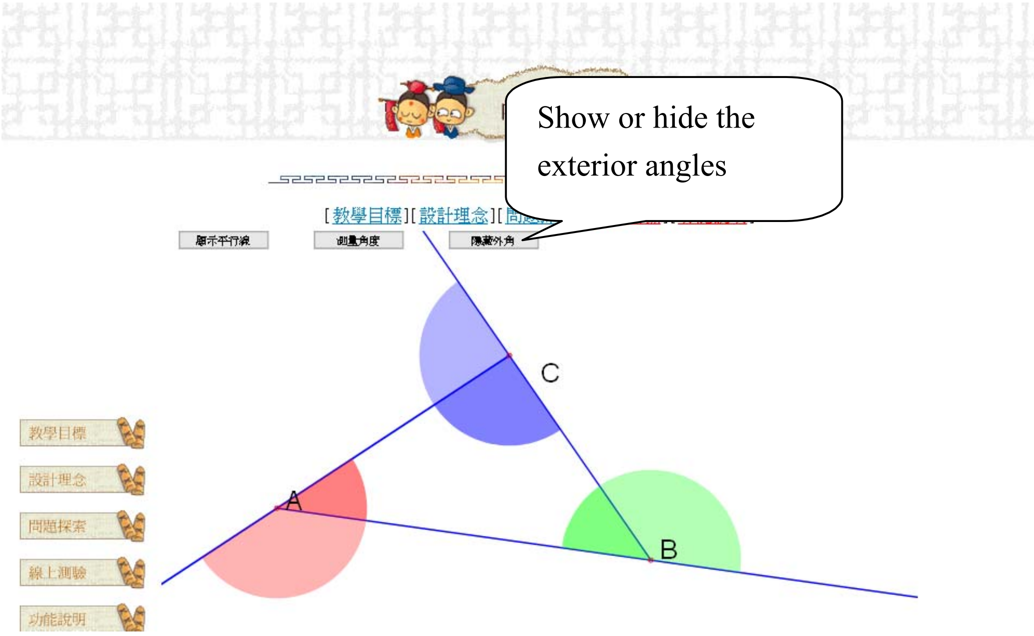
Step2: Drag the vertex of the angle to meet the point on the button line and rotate it to an appropriate position so that the three angles will be combined to be a flat angle.



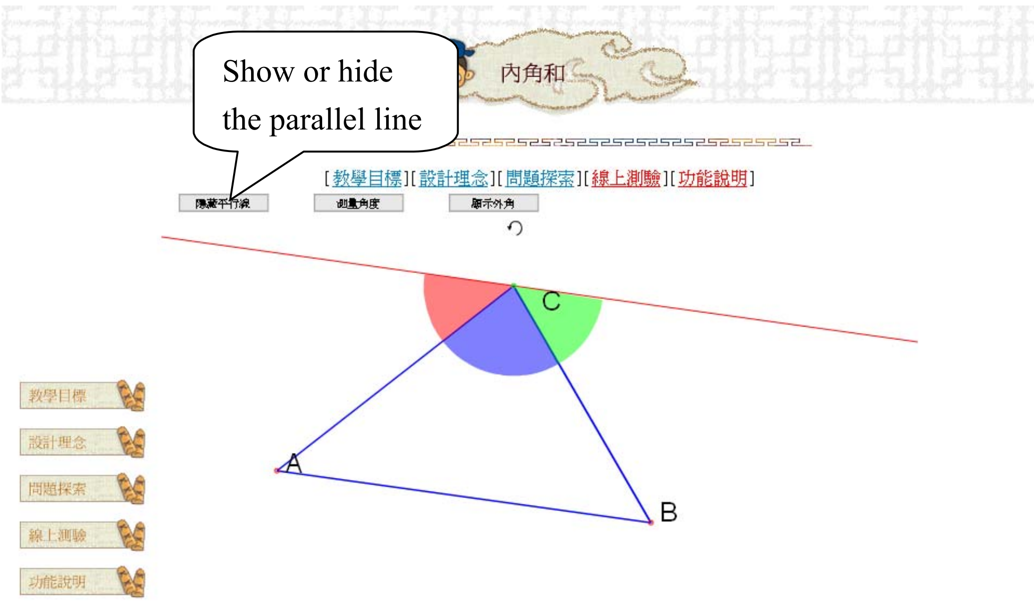
Step3: Press the angle measurement button and input the name of the angle to show the size of the angle. Click the “X” sign to hide the measurement of the angle.



Step4: Show the three exterior angles. It can be used to explore the relationship between interior angles and exterior angles.



Step5: Show the parallel line through point C. Drag and combine the there angles to be a flat angle.



Conclusion

In our study, we have also conducted a quasi-experimental design to study the effect of the applications of these electronic tools on students learning of basic geometric concepts. It was found that students in the experimental group performed better on questions of the basic concept level. And higher ability students seem to benefit from these learning activities. Seventy percent of the students agreed that integrating these FLASH tools into instruction help their mathematics learning, and eighty-six percent of them like to have similar curriculum in the future. We hope our efforts to be a beginning. If we hope teachers to integrate technology in teaching, we should develop abundant resources that are useful in their teaching. Then teachers would like to use them in their classes and finally they will share experiences in supporting this development.

Reference

Black, J. B. & McClintock, R. O. (1996). *An interpretation construction approach to constructivist design*. In Wilson, B. (Ed.), Constructivist Learning Environments. Educational Technology Publications, Englewood Cliffs, NJ, pp. 23-31.

Jonassen, D. H. (2000). *Computers as mindtools for schools: Engaging Critical thinking*(2nd ed). Upper Saddle River, N. J. Prentice Hall.

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