华东师范大学亚洲数学教育中心第十一期研究生学术论坛

留美十年期间对于数学教育的思考及经验分享

报告人：沈轶骅 哥伦比亚大学教师教育学院 博士候选人

报告时间：2020.09.09 周三下午 3:30-5:00

报告地点/形式：闵行校区数学楼401报告厅+钉钉平台

TEACHERS COLLEGE
COLUMBIA UNIVERSITY
A Graduate School of Education, Health & Psychology

Do Now Activity

➢ 一、选择题

1. 李白是一位……（　　）

A. 诗人　　B. 剑客　　C. 既是诗人也是剑客　　D. 都不是

➢ 二、填空题

1. 写出下列图片中人物的名字。

A.

B.

C.

D

故事一

S: 今天我听了一节数学课，产生了一些想法。

I: 哦？什么想法呢？

S: 老师在上课的时候用了哆啦A梦的百宝袋，然后我就想，现在的孩子还看哆啦A梦吗？

I: 确实呢，现在的孩子知道哆啦A梦的应该很少了吧。其实我之前也遇到过类似的情况。

S: 嗯。怎么说呢？

I: 之前我在上 Early Childhood Math Education 的课的时候设计过一份教案……

认识负数

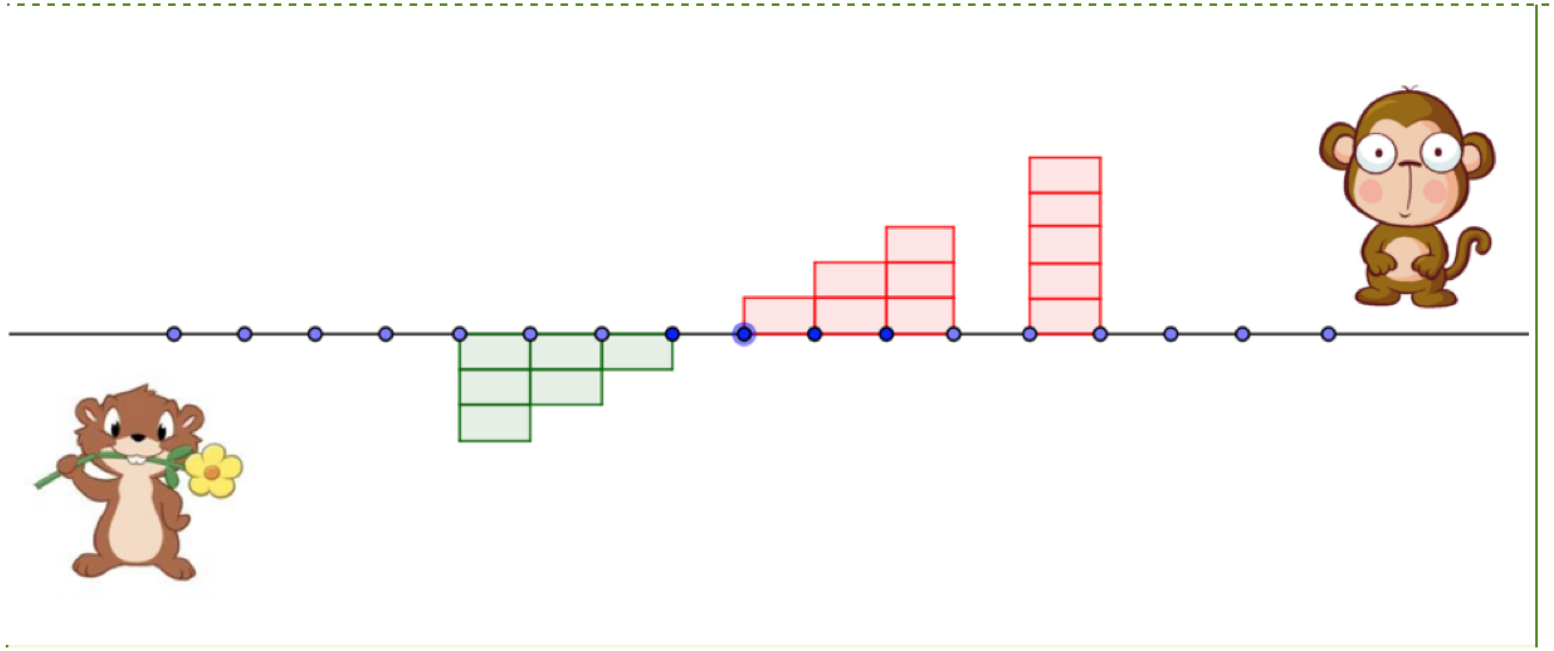
New toy	$8	Movie ticket	$10
Wash the dishes	$5	Clean the bathroom	$15
Ice creams	$3	Colored pencils	$12
New T-shirt	$22	Clean the bedroom	$15
Walk the dog	$15	Wash the cloth	$10
How much money do you have at the end?			$

Theoretical basis:

For the same set of reasons, I created an interesting background story with a well-known character for the last activity. However, the niffler in the story is mainly used to increase the engagement of children in the tasks through his direct conversations with children (Chase, Chin, Oppezzo, & Schwartz, 2009). The character is not mathematically useful in helping children to understand the concepts.

Author
I have never heard of this character!

认识负数



Background story: Monkeys and gophers are building new houses so that everyone will have a warm place to stay during the winter. While monkeys are building houses above ground, gophers are building houses below ground. After several days of hard work, an interesting pattern can be observed in their constructions.

Author
These color choices could be difficult for children with colorblindness.

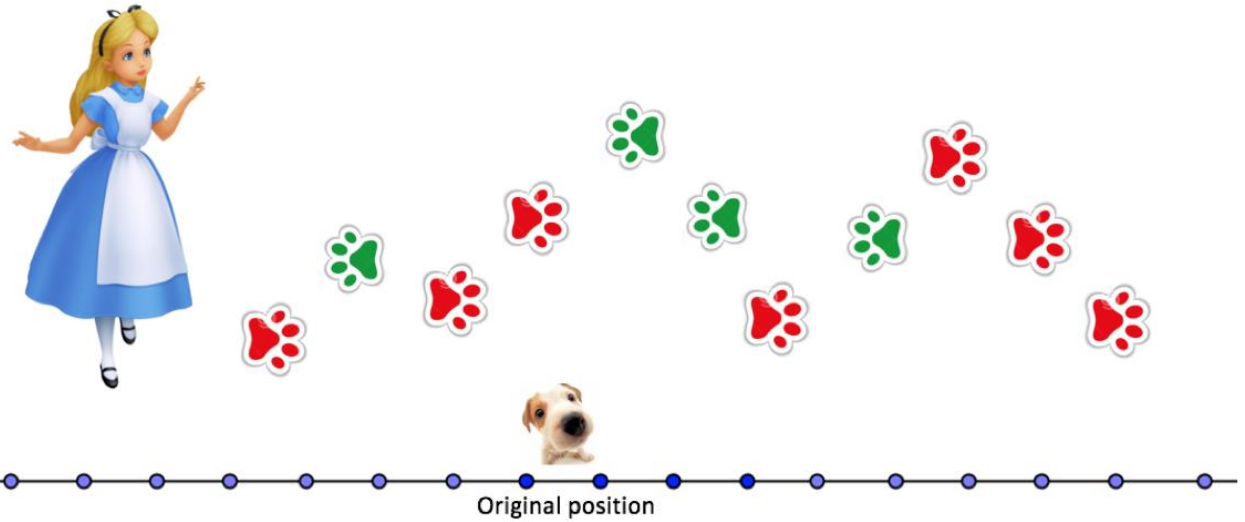
Author
This representation may be confusing because it is representing numbers both horizontally (along the number line) and vertically (with the height of the houses). For this task, the vertical representation would work best.

The picture is a *very* abstract representation of a "house" built by a monkey or gopher. It might help to make the drawing slightly more concrete—at least for the first example. Maybe even just putting a monkey or a gopher inside one of the floors would help with this. (But I'm not sure—you would need to try this out and see how it works.)

Why is the fourth column for the monkey missing? I think this may make identifying the pattern difficult. I would first start with having children extend patterns that have consecutive pieces of the pattern given, and then I would move to filling in gaps in the pattern.

Author
Many children are familiar with monkeys, but I'm not sure so many children are familiar with gophers. An introduction to this animal and where it lives may be necessary.

认识负数



Background story:

Cinderella's stepmother asks her to find a missing puppy. If Cinderella cannot find him, the stepmother will ask her to leave the house. Cinderella only knows the original position of the puppy and some footprints left by him. Could you help Cinderella to identify the final position of the puppy so that she will not be forced to leave the house?

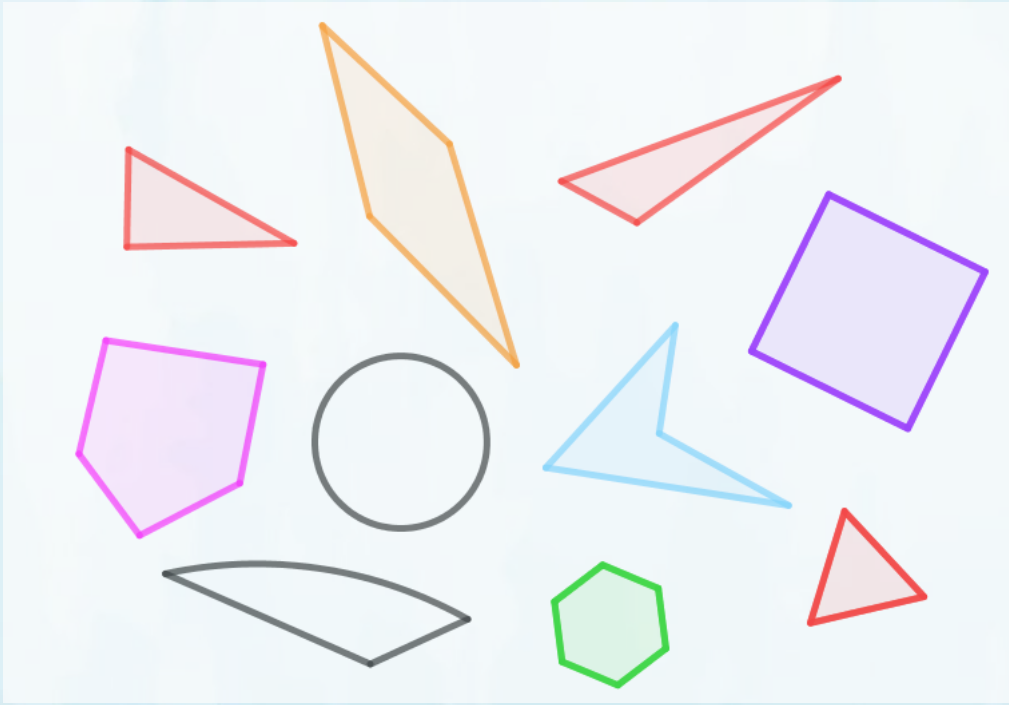
Author

You may want to choose another context for this activity. There are many children with stepparents, stories with a "mean stepparent" aren't great stories to use in school.

Author

Again, this representation may be confusing because it is representing numbers both horizontally (along the number line) and vertically (with the number of foot prints). Using a representation of a dog walking forward and back is a good idea; however, columns of foot prints seems too abstract. Instead, I would use only a horizontal representation here. I would show a set of red foot prints going forward three steps and then a set of green foot prints going back three steps to show that when the dog walks forward and back the same number of steps, he ends up in his original location. You could also have kids act out this scenario. Having kids walk forwards and backwards a designated number of steps may make the abstract concept of adding positive and negative numbers more concrete for them.

小结



- 从学生的角度去看问题
- 从不同的角度去看问题
- 认真观察儿童的行为
- 仔细聆听儿童的话语
- 辩证分析儿童的行为和话语
- **Ask probing but not leading questions**

故事二

I: 你能形容一下 增强现实AR / 几何画板GSP 给你的第一印象吗？

S1: 它们都非常的好玩，使数学课变得生动有趣。

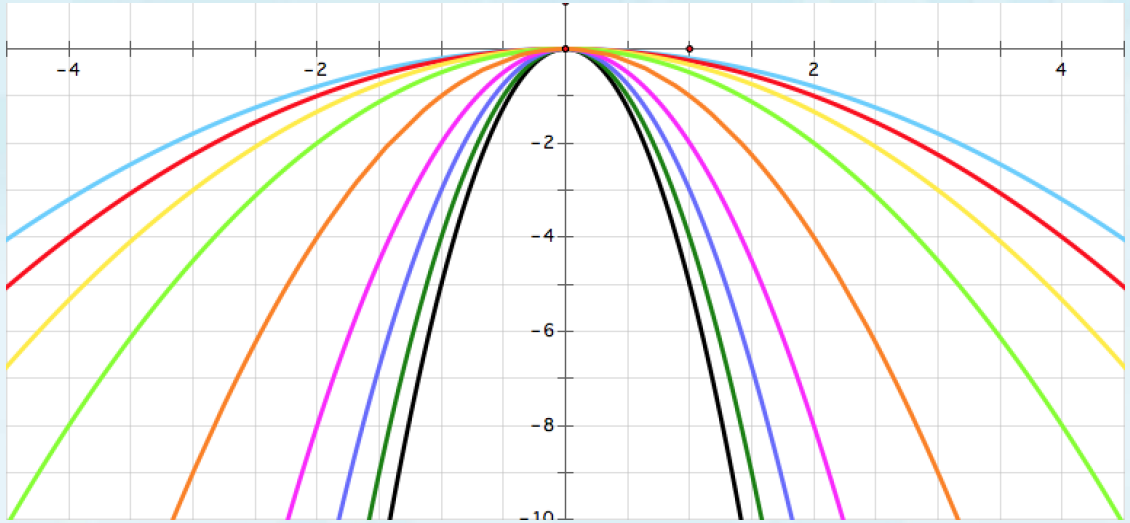
S2: GSP使知识点更容易被理解，AR则互动更多一点，参与感更强烈。

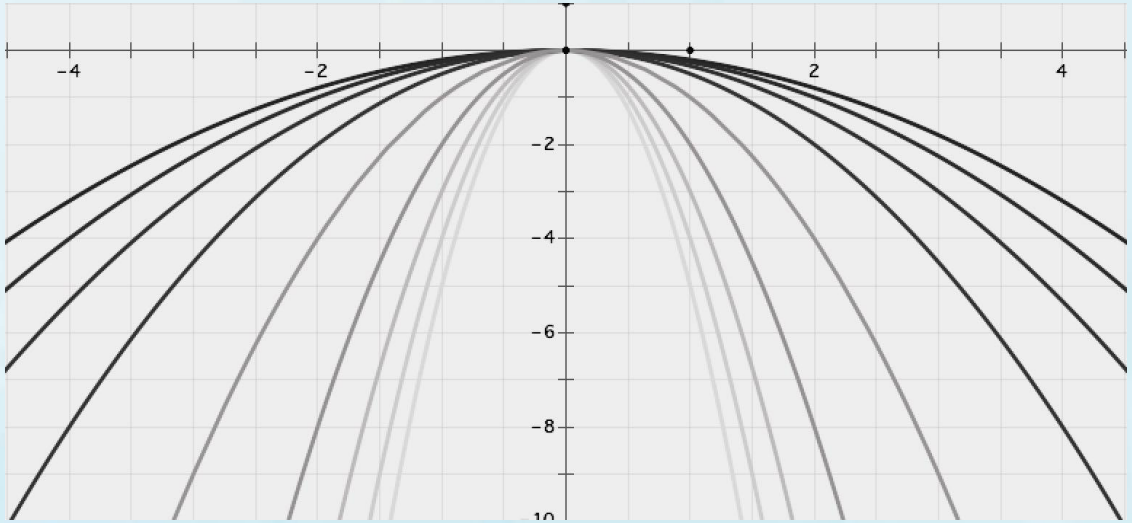
I: 你以后想继续用这种方式来学习吗？

S3: 当然想，每节课都用的话，我一定能把数学学好。

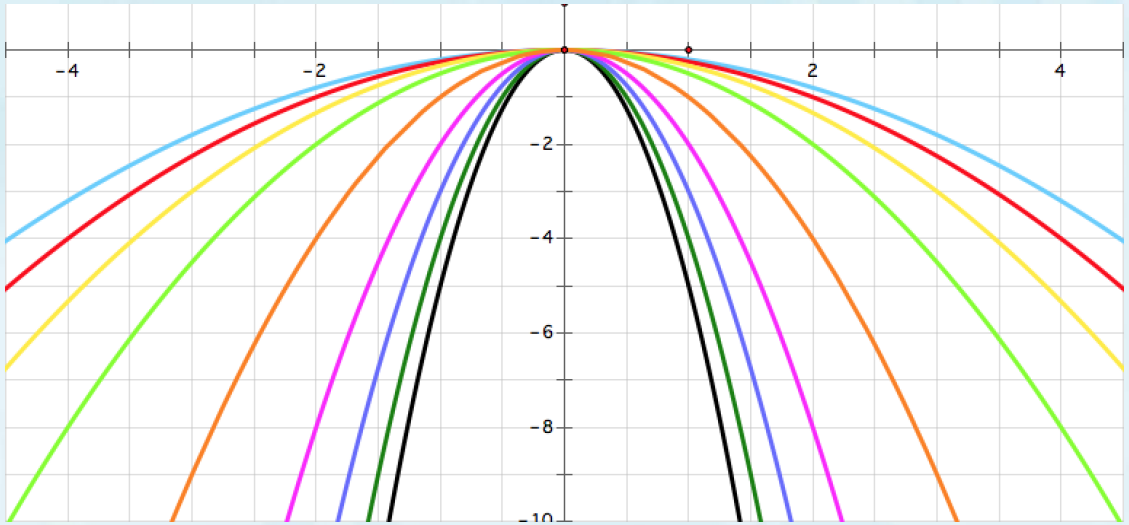
S4: 无所谓，觉得有点浪费时间。

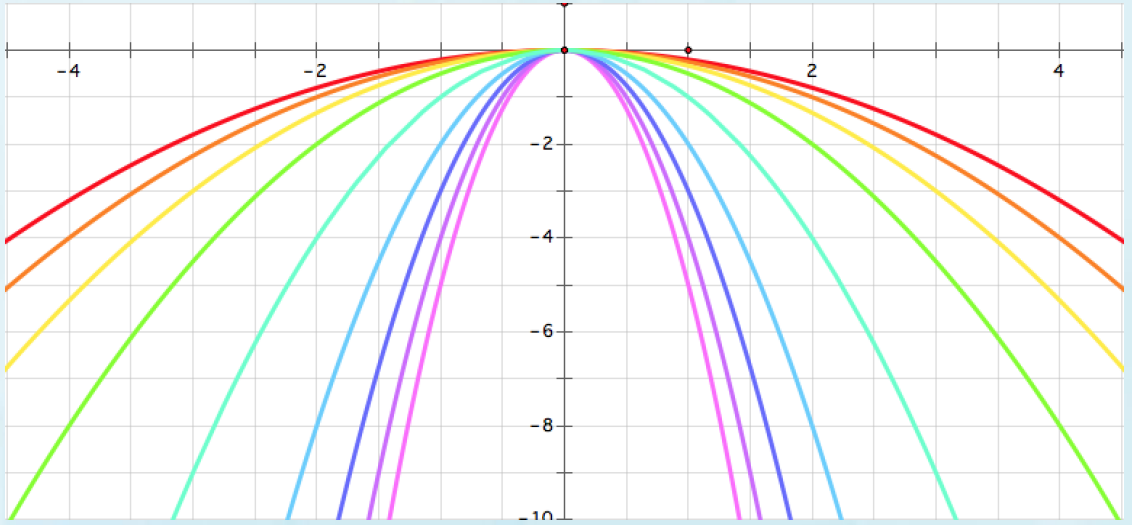
多彩的教学



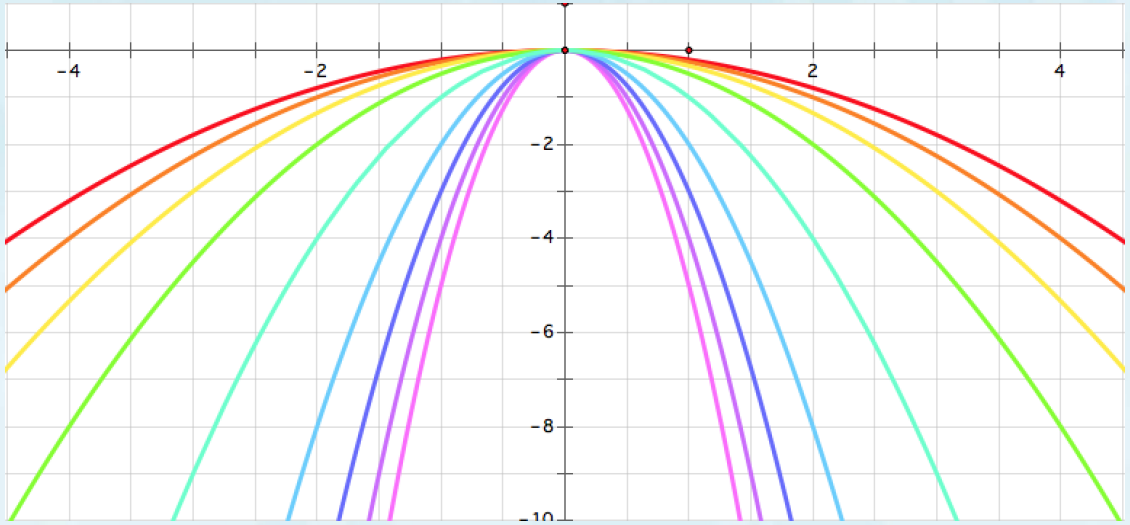


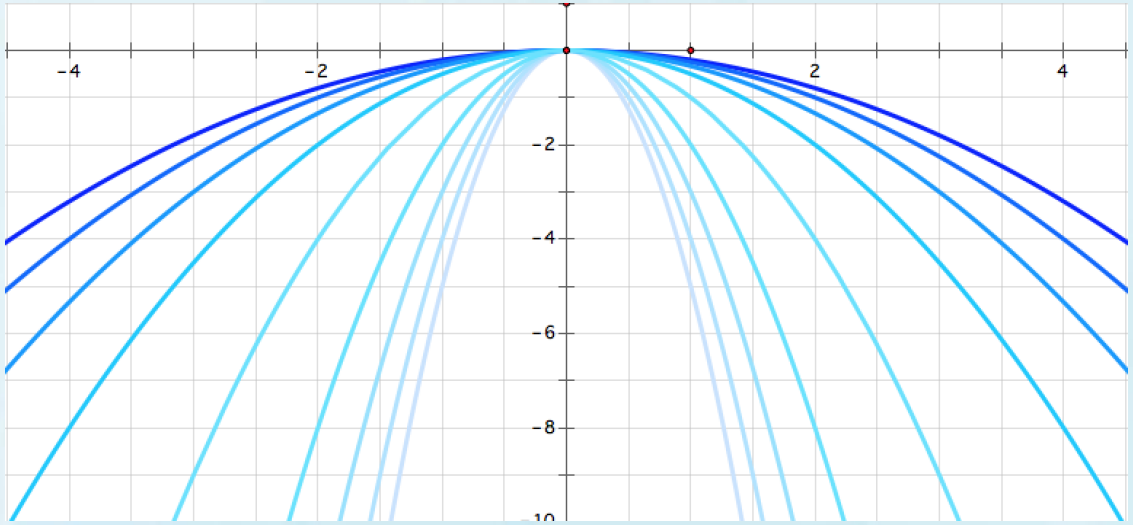
多彩的教学



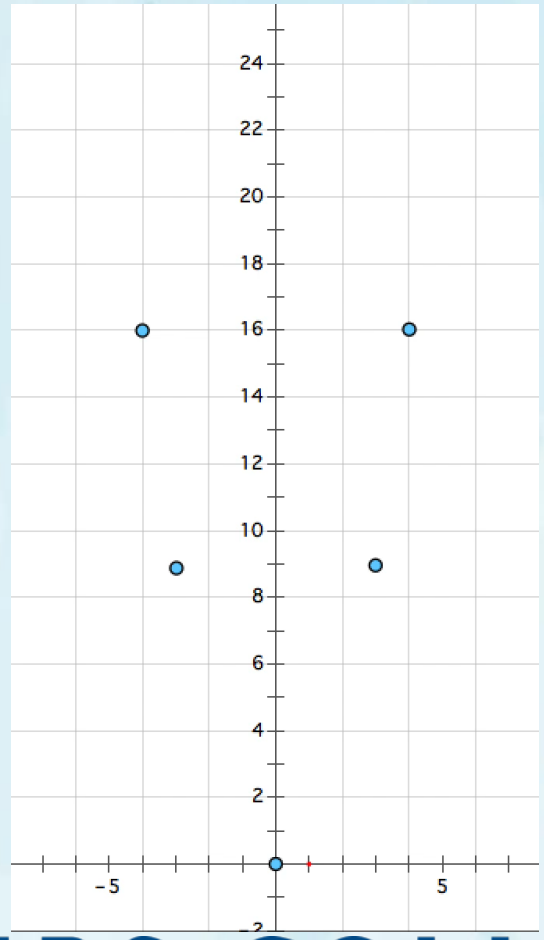


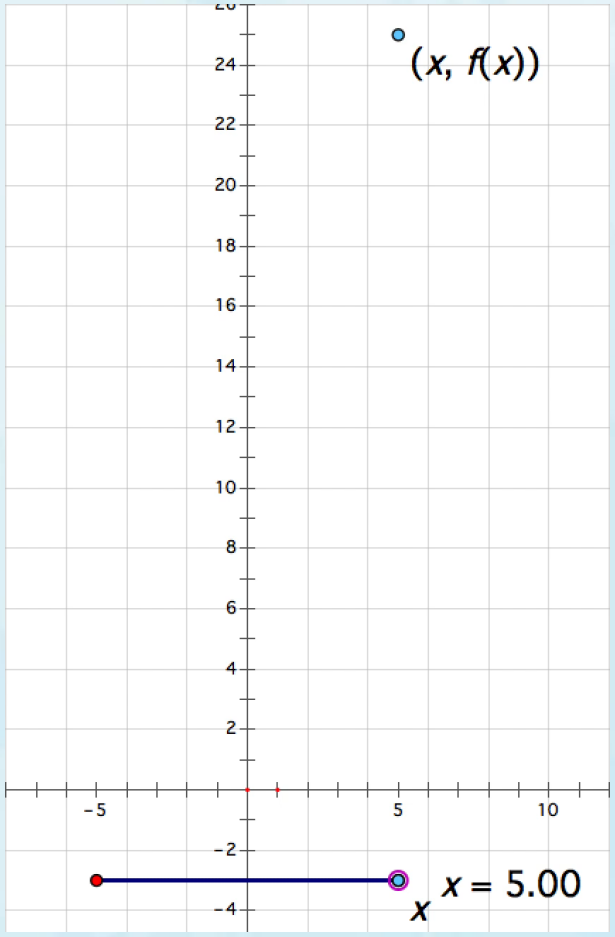
多彩的教学





多变的教学

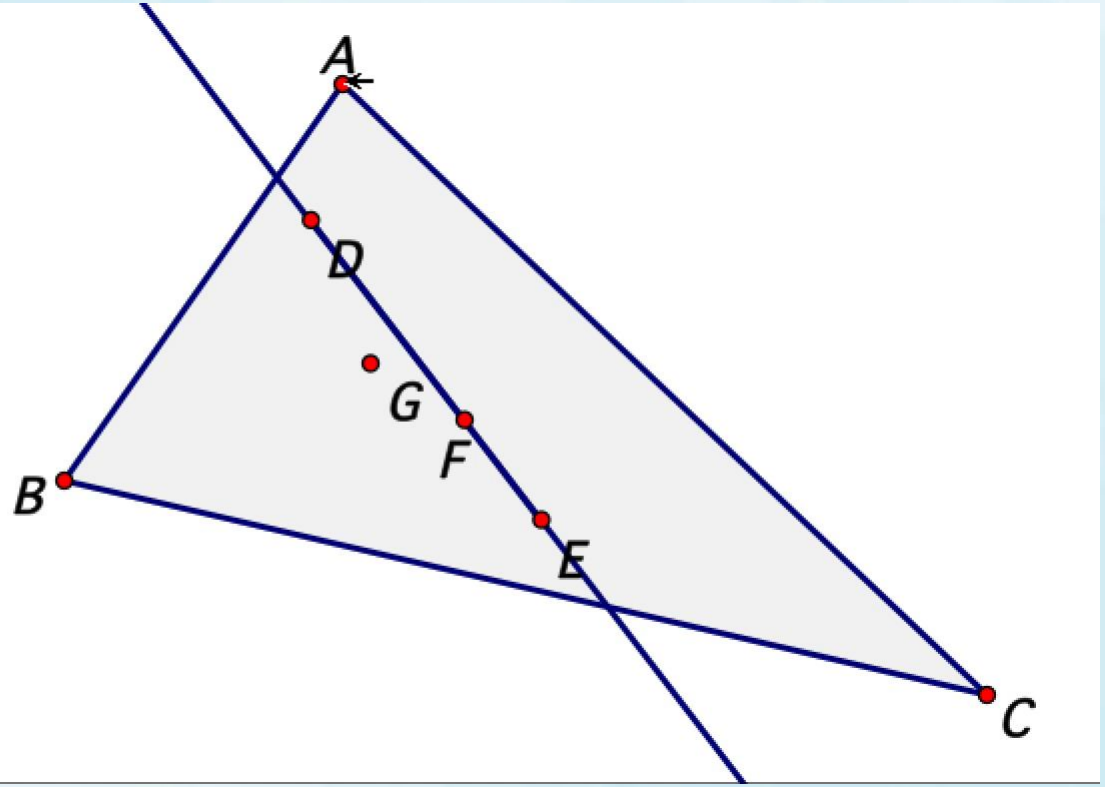

24
22
20
18
16
14
12
10
8
6
4
2
-5
5


(x, f(x))
24
22
20
18
16
14
12
10
8
6
4
2
-5
5
10
-2
-4
x = 5.00
x

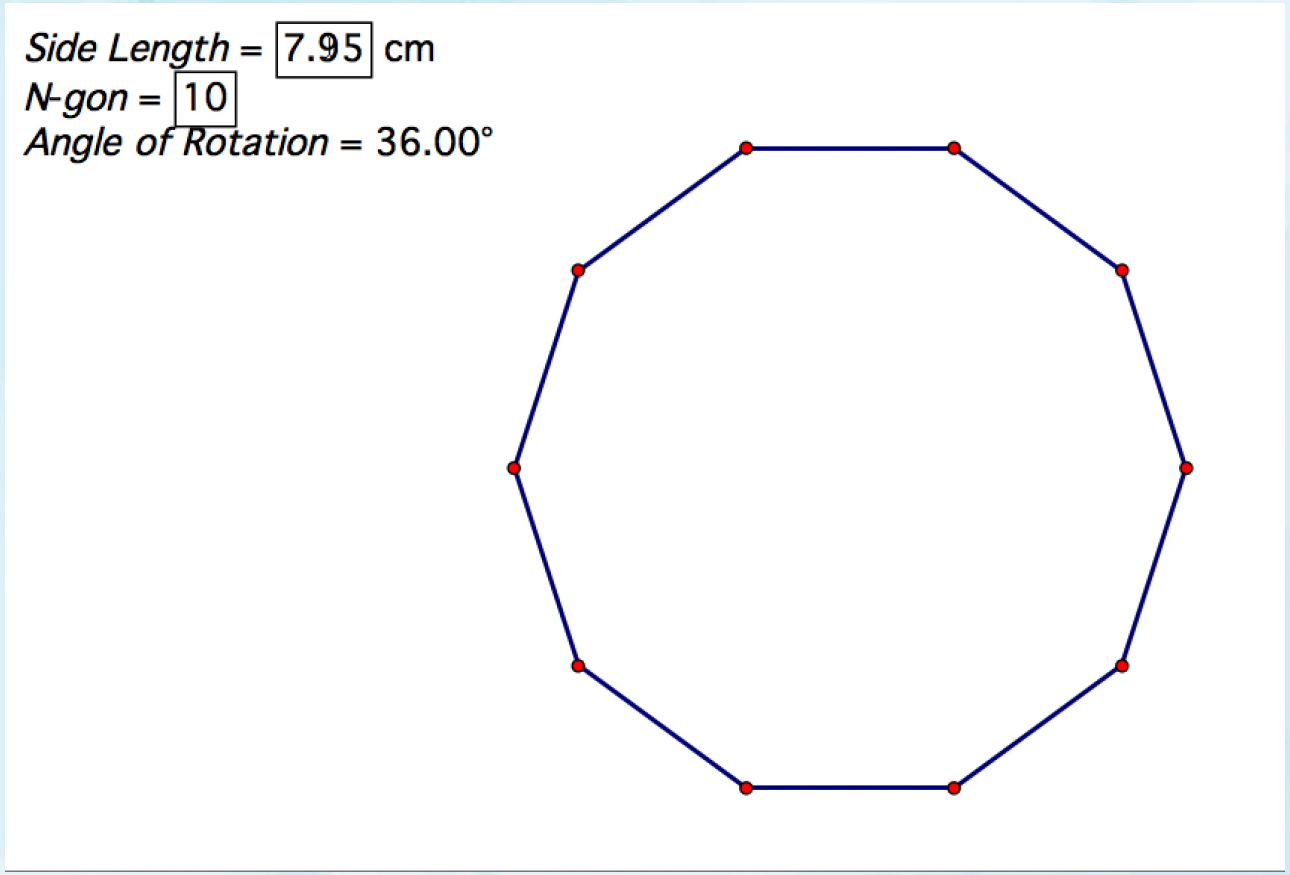
多变的教学

Orthocenter: D
Circumcenter: E
Centroid: F
Incenter: G

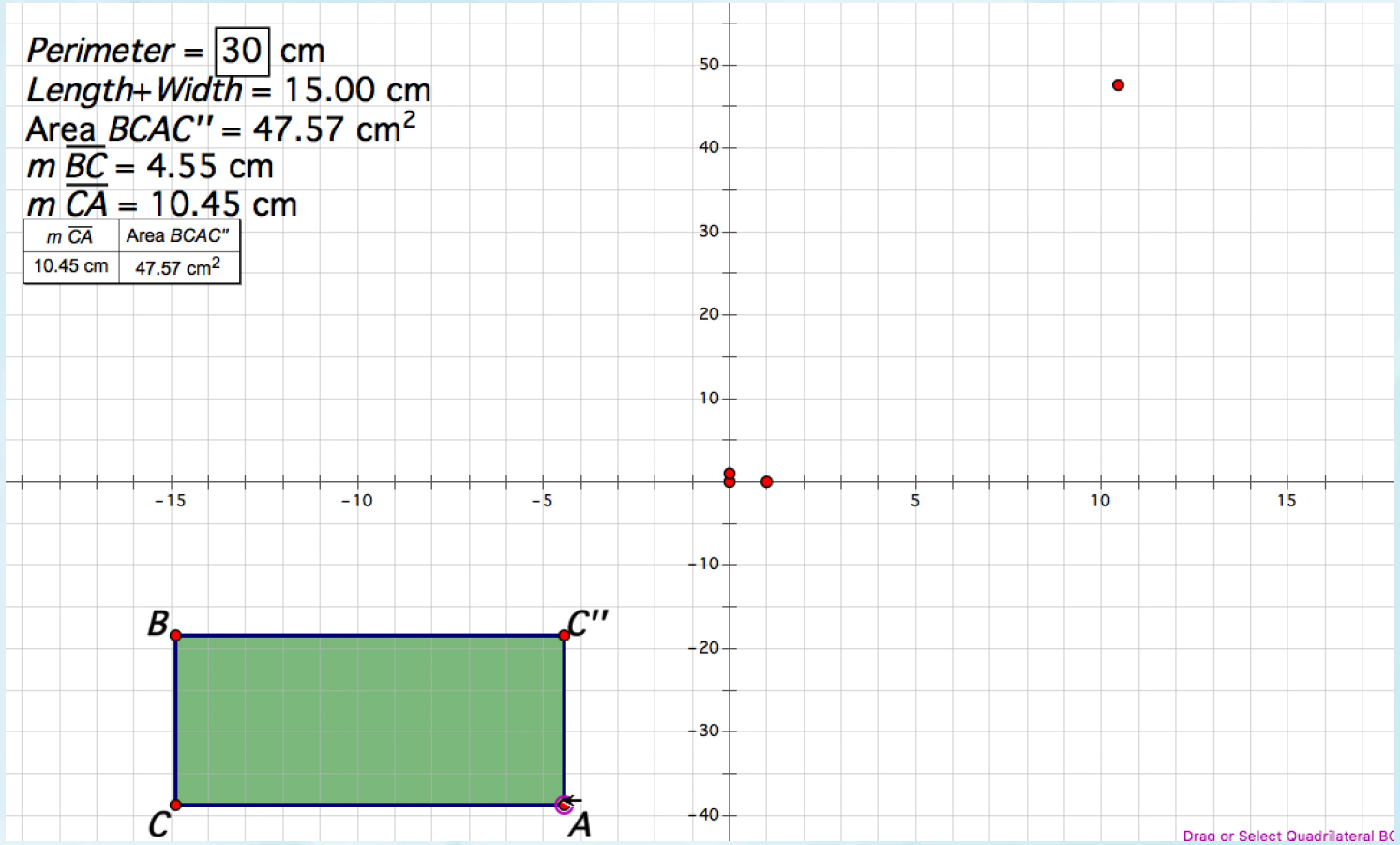
$m\,\overline{AB} = 8.53$ cm
$m\,\overline{CA} = 15.65$ cm
$m\,\overline{BC} = 16.70$ cm



多变的教学



多变的教学

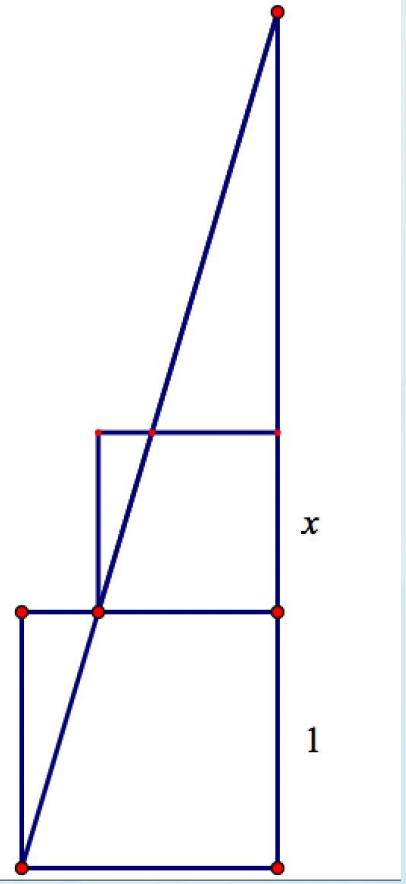

Perimeter = 30 cm
Length+Width = 15.00 cm
Area BCAC'' = 47.57 cm²
m BC = 4.55 cm
m CA = 10.45 cm
m CA | Area BCAC''
10.45 cm | 47.57 cm²
B
C''
C
A
Drag or Select Quadrilateral BC

多变的教学

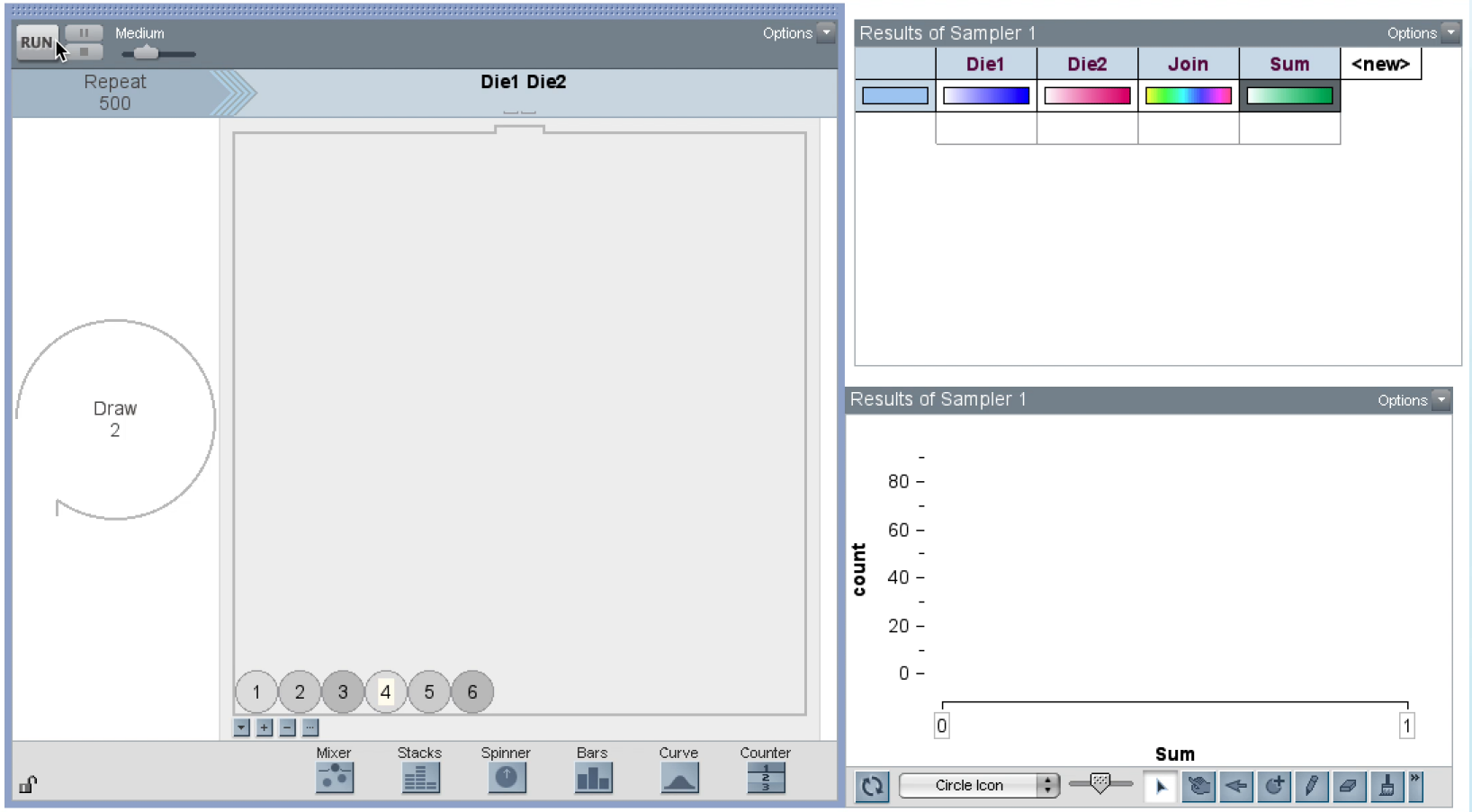
Increase the value of n, then observe the changes of the picture and use the knowledge of similar triangles to prove the following equation:

$$\frac{1 + x + x^2 + x^3 + x^4 + \ldots\ldots}{1} = \frac{1}{1 - x}, \text{ for } 0 \le x < 1$$

$n =$ 1



多变的教学


RUN
Medium
Options
Repeat
500
Die1 Die2
Draw
2
1
2
3
4
5
6
Mixer
Stacks
Spinner
Bars
Curve
Counter
Results of Sampler 1
Options
Die1
Die2
Join
Sum
<new>
Results of Sampler 1
Options
count
80
60
40
20
0
0
1
Sum
Circle Icon

小结

- 是否能调动学生的积极性
- 是否具有教学意义
- 对不同学生影响的差异性

故事三

GSI: Let’ s discuss about the dialogues between Socrates and Plato we’ ve learned in today’ s class.

S1: In the first dialogue, Socrates ……

I: 唉, 怎么办, 总得说点什么, 要不然拿不到A了.

S2: But what Plato said ……

I: 好紧张啊, 语法有没有问题, 他们听得懂不, 再组织下语言吧.

S3: From my perspective, the logic between ……

I: 啊, 这就是我想讲的啊, 赶紧再想个.

GSI: Very interesting! Now, let’s discuss about …..

I: 怎么就结束了, 等下一问题吧, 下一个问题一定要.....

什么是讨论

Instructor: Dr. Stephen Brookfield
Class: *Discussion as a Way of Thinking*
Book: 50 Great Ways to Get People Talking

- **Conversation:**

  An exchange of thoughts and feeling where general cooperation prevails.

- **Discussion:**

  Disciplined & focused exploration of mutual concerns but with no end point predetermined in advance.

➢ Circle of Voices

1. Teachers can start by posing a question, issue, or problem to the students.
2. Give students two minutes to think quietly about their responses. Teachers in this phase should stress **the importance of silence** and make sure this is observed. Students are suggested to take down notes summarizing their thoughts.
3. After two minutes, **each student in the group takes a turn** to present his or her initial responses to the question, issue, or problem posed. They are asked to keep their responses short, usually within one minute. In this phase, teachers should stress that no interruptions are allowed as each student gives his or her responses, not even supportive statements such as, “Yes, I’ve found that’s true.”
4. Once the initial round of individual responses is over, the group can move into the second round of open discussion which is more familiar to most teachers.

➢ Circular Response

1. Teachers can start by posing a question for group consideration.
2. Student whoever wishes to start does so by speaking for up to a minute, responding to the question. No interruptions are allowed.
3. Once the first speaker has finished, the person to the speaker's left then speaks for up to a minute. However, he or she strives to **build on the preceding speaker's comments and uses them as a springboard for his or her own contribution.**
4. The process continues around the circle. The comments people offer don't have to be in the form of agreements. It's fine to express dissent from the previous speaker's contribution.
5. Once everyone has spoken, the group moves into open conversation with no ground rules.

➢ Snowballing

1. Teachers can start by posing a question students wish to discuss.
2. Students begin with a minute or two of silent reflection to organize their initial thoughts.
3. Students share their initial thoughts with one other person.
4. After a few minutes, pairs are asked to find another pair and to share emerging responses to the question.
5. After another few minutes, quartets are asked to join up to form octets. Each quartet share differences, and new questions being expressed.
6. The exercise ends when the sharing reached the point when everyone is involved.

小结

- 沉默的重要性
- 规则的重要性

故事四

W: 你为什么要选择数学史这个主题呢，换言之，研究它的重要性和意义在哪里呢？

I: 研究数学史可以让我们了解数学的发展规律，更好地认识数学概念和数学方法。

W: 具体说说。

I: 比如前人在研究数学时所犯的错误我们可以避免，优秀的经验我们可以借鉴。

W: 你能更加具体的阐述一下吗？

I: 额……沉默（Silence！）

W: 没事，我就随便问问。

K: 研究数学史的意义可多了，比如……

……

数学史

- 了解数学的发展规律，更好地认识数学概念和数学方法
- 学习前人优秀的经验，规避前人所犯的错误
- 学习数学家们优秀的品质和精神
- 体会数学与人类文明发展的关系

Attention:
真实性和可靠性

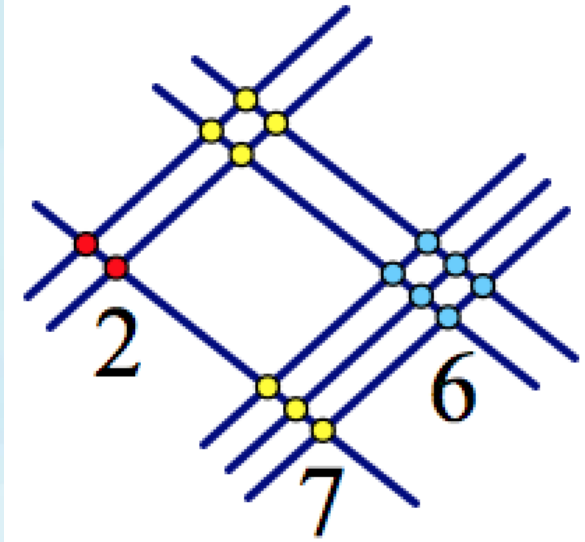
运用数学史教数学

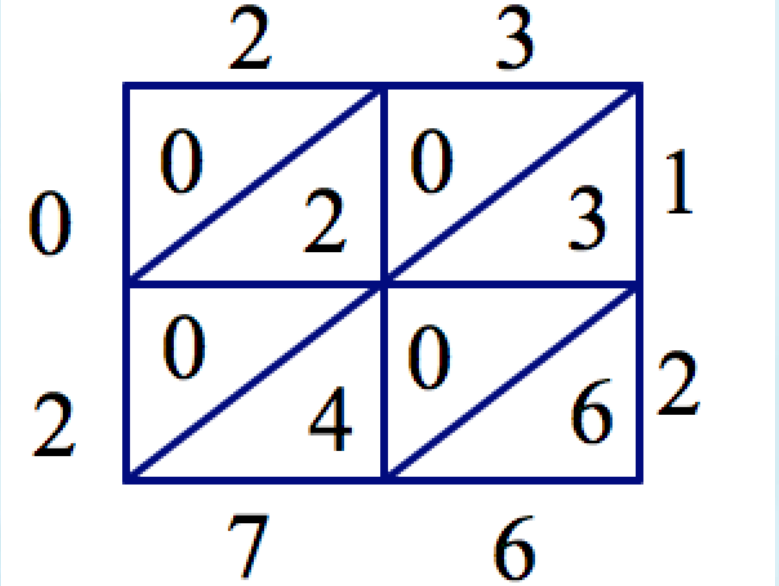
- 高斯 Gauss
- 泰勒斯 Thales
- 希帕索斯 Hippasus
- 阿基米德 Archimedes

Attention:
是否具有教学意义

文化的碰撞

$$\begin{array}{r} 23 \\ \times\ 12 \\ \hline 46 \\ 23 \\ \hline 276 \end{array}$$





语言的碰撞

2] In einem Stall leben Hühner und Kaninchen. Alfred zählt 171 Köpfe und 498 Beine.

Wie viele Hühner und wie viele Kaninchen wohnen in diesem Stall?

Chickens and rabbits live in a shed. Alfred counts 171 heads and 498 legs. How many chickens and how many rabbits live in this shed?

5] Ein leeres Schwimmbecken kann durch die Zuflussleitung in 15 Stunden gefüllt werden. Ist das Becken voll, so dauert es 20 Stunden, um das Wasser wieder ablaufen zu lassen.

An empty swimming pool can be filled by the inflow line in 15 hours. If the pool is full, so it takes 20 hours in order to let the water drain off again.

小结

- 跨领域的学习
- 跨地域的学习
- 取之精华，弃之糟粕，切莫喧宾夺主

故事五

P: 今天我们来讨论一下如何教多边形内角和公式。

I: 把多边形分割成三角形，用三角形的内角和(180度)乘以三角形的个数(n-2)。

P: 很好，这是最常见的教学方法。有没有其他的方法呢？

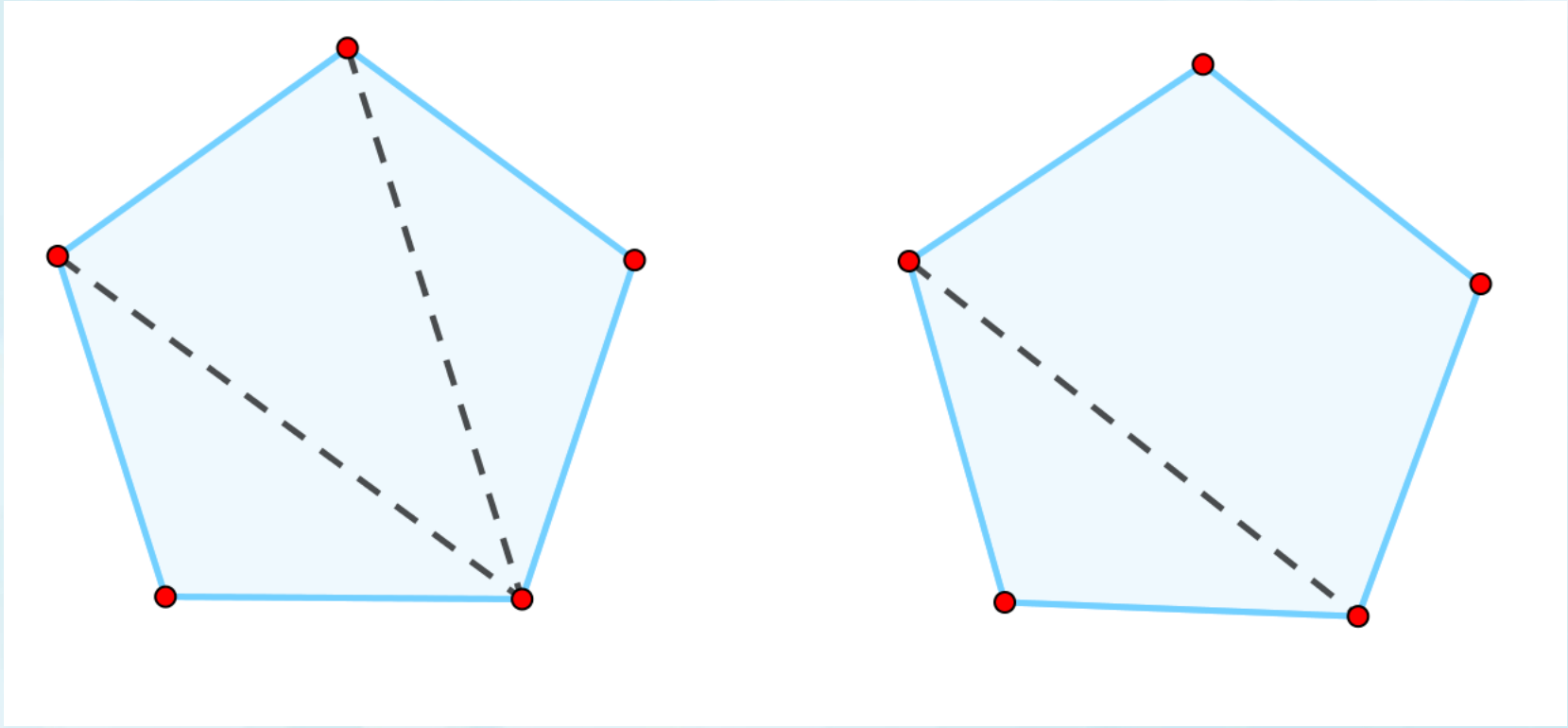
S1: 可以把五边形分割成一个四边形和一个三角形？

P: 对，可以把多边形分成多种形状，但不同的多边形的结果就不同了。

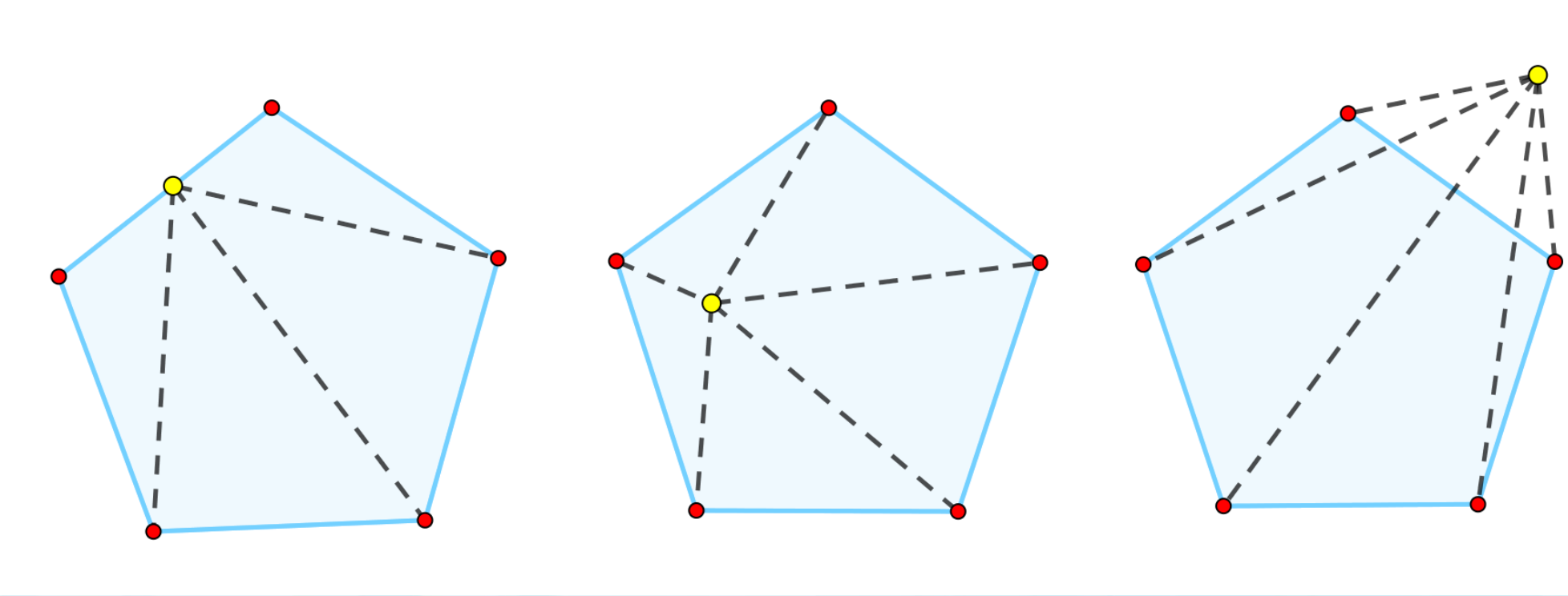
S2: 那就只有分三角形了啊。

P: 具体怎么分呢？只有一种分法吗？

分割五边形



分割五边形



小结

- 用批判的眼光去看待已有的教学方法

总结

- 跨领域的学习
- 多角度的思考
- 批判性的审查

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

Q & A

Thanks

TEACHERS COLLEGE
COLUMBIA UNIVERSITY
A Graduate School of Education, Health & Psychology

Note: For more information about using technology to teach mathematics, please visit Dr. Wasserman's personal website:

http://www.columbia.edu/~nhw2108/wasserman/index.html