Shanghai Math

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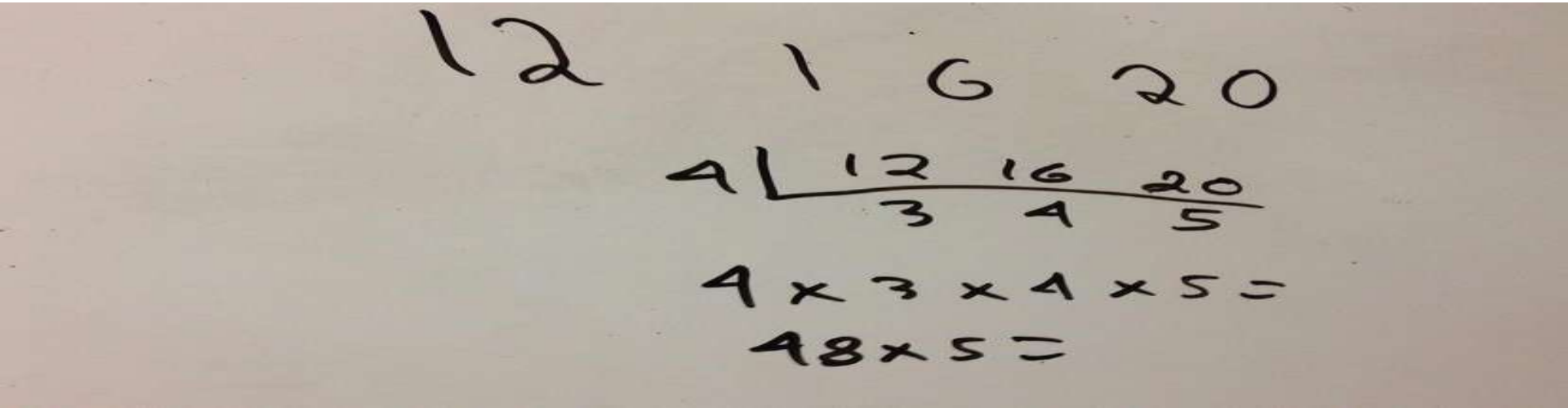
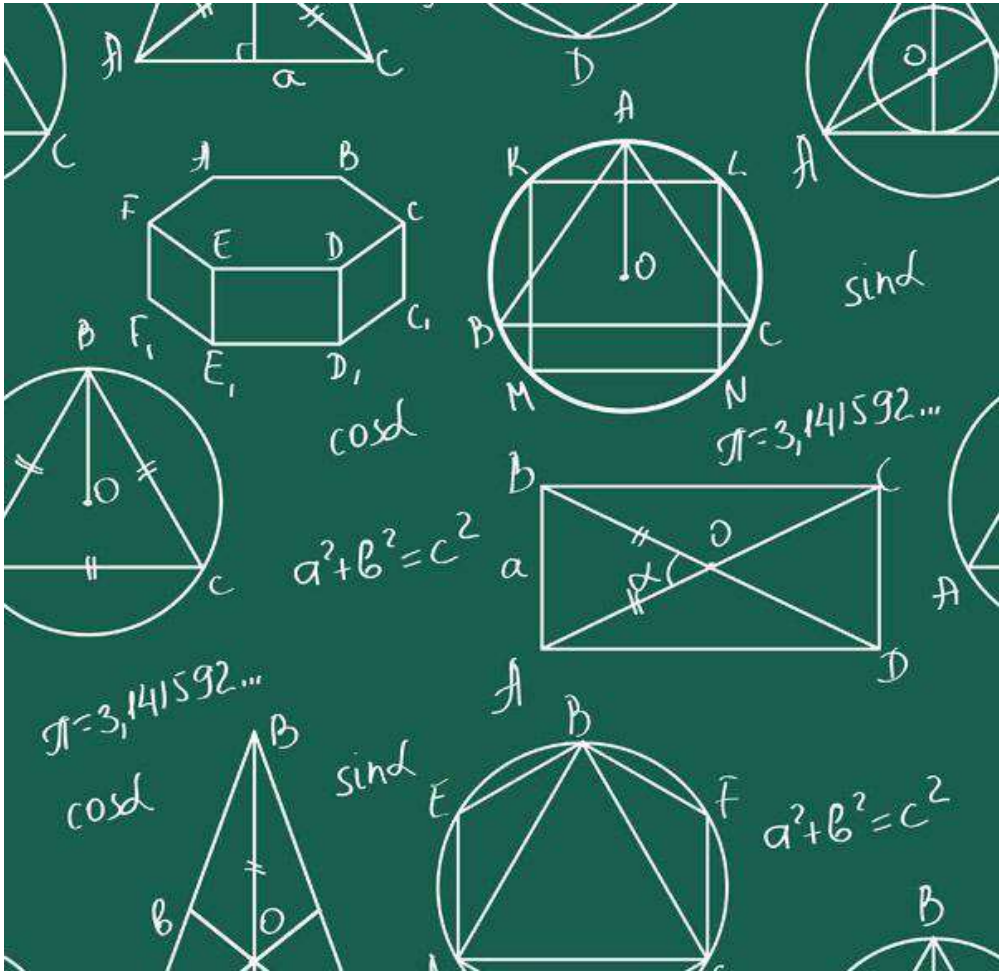
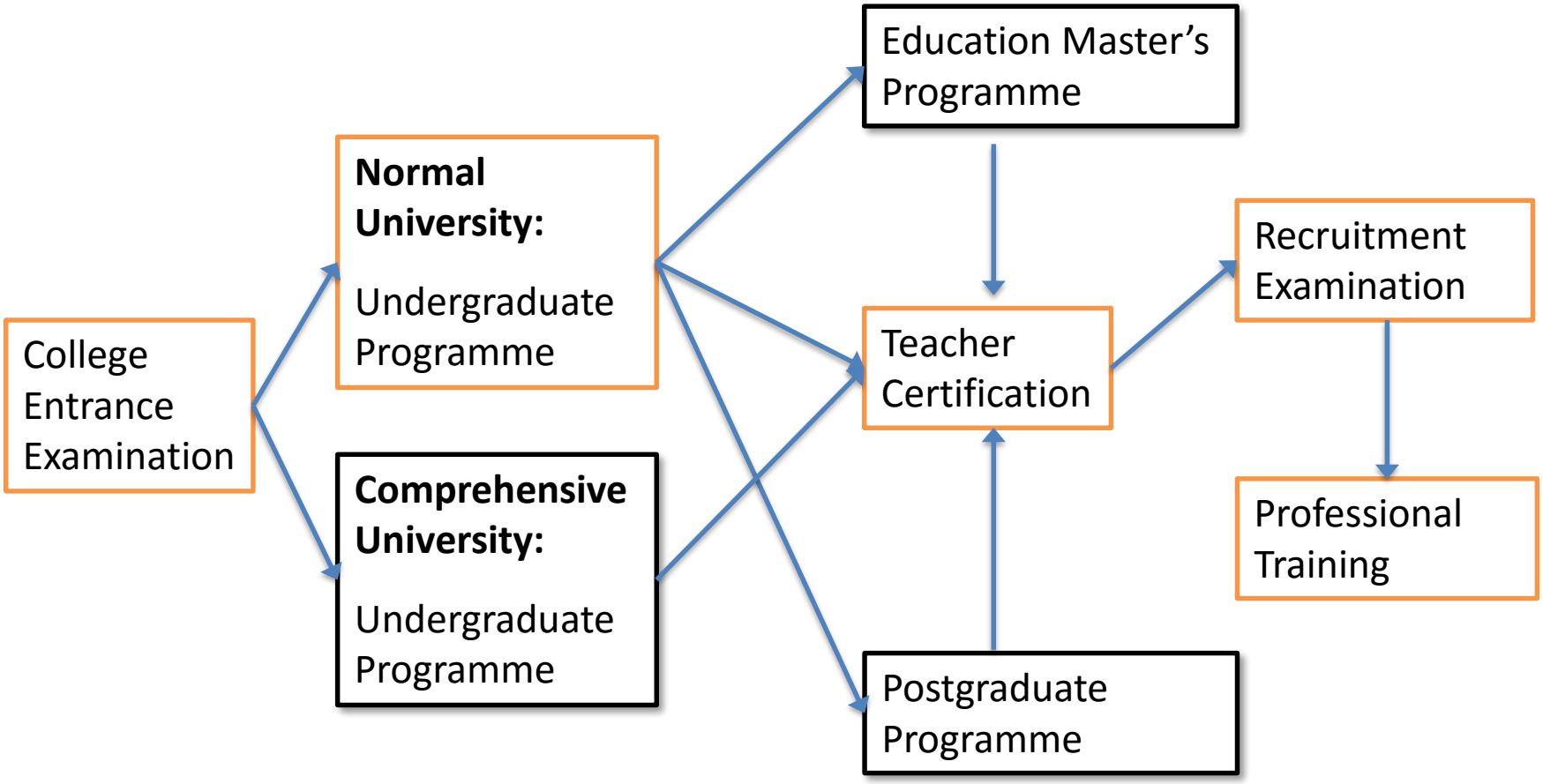


OUTLINE

- **Education policy**
- **Math curriculum**
- **Math teacher**
- **Math teaching**



Education Policy: from Student to Teacher



Shanghai Teacher Recruitment Standards

Established by Shanghai Education Commission:

- **Kindergarten**: Diploma or higher
- **Primary school:** Undergraduate/Bachelor or higher
- **Junior/Senior/Vocational secondary school**: Undergraduate/Bachelor or higher

Recruit round 5,000 teachers each year

- **857 secondary education schools (general 768, and vocational 89)**
- **757 primary schools**
- **29 special education schools**
- **1, 462 kindergartens**
- **36 international schools**

Shanghai Math Curriculum

The city has its own curriculum and textbooks

Philosophy of Shanghai's Math Curriculum

(From Shanghai School Math Curriculum Standards, 2004)

- Develop students' mathematical literacy
- Focus on fundamental aim: Mathematics for all
- Diversify curriculum for different learning needs
- Integrate technology into the math curriculum

- Pay attention to learning process
- Guide students to explore
- Strengthen educational function of evaluation
- Encourage individualized development of students

Math Textbooks

- Almost all Shanghai schools use the same math textbooks.
- Textbook writers work in committees of experts:
  - Organized by Normal university
  - Use feedback systematically gathered from math teachers
  - Drafts inspected and approved by Shanghai Education Commission for publication.
- Textbook writers also prepare supplementary materials:
  - Teacher guides and reference materials for teaching.
  - Exercise books for students to practice math after school

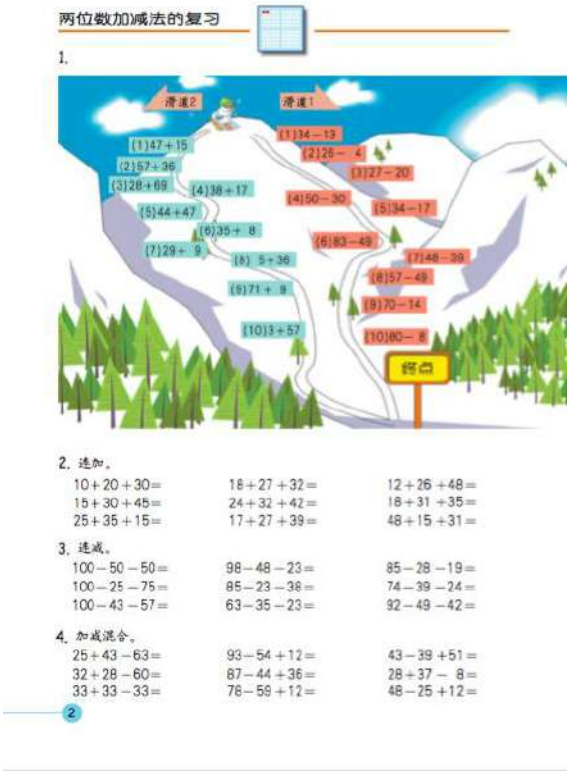
Shanghai Math Curriculum

Textbook

Exercise book

Teacher guide

Textbook



两位数加减法的复习

1.

滑道2 滑道1

(1)47+15 (1)34−13
(2)57+36 (2)25− 4
(3)28+69 (3)27−20
(4)38+17 (4)50−30
(5)44+47 (5)34−17
(6)35+ 8 (6)83−49
(7)29+ 9 (7)48−39
(8) 5+36 (8)57−49
(8)71+ 9 (9)70−14
(10)3+57 (10)80− 8

终点

2. 连加。

10+20+30=	18+27+32=	12+26+48=
15+30+45=	24+32+42=	18+31+35=
25+35+15=	17+27+39=	48+15+31=

3. 连减。

100−50−50=	98−48−23=	85−28−19=
100−25−75=	85−23−38=	74−39−24=
100−43−57=	63−35−23=	92−49−42=

4. 加减混合。

25+43−63=	93−54+12=	43−39+51=
32+28−60=	87−44+36=	28+37− 8=
33+33−33=	78−59+12=	48−25+12=

2

Exercise book

1 两位数加减法的复习

课本第2页

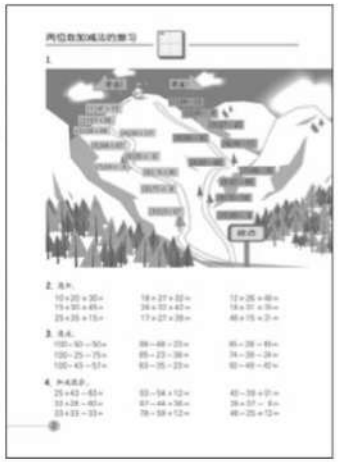
1 口算。

69−6=	36+7=	44−5=
77−9=	76+8=	23+25=
34+43=	55−13=	25+10=
86−12=	38+59=	62−17=
33+18=	43+38=	43−38=

2 直接写出得数。

(1) 24+16+37=	54+26+15=	46+17+24=
(2) 45−15−22=	77−24−16=	54−27−27=
(3) 72−38+38=	25+38−34=	61−22+28=

Teacher guide



两位数加减法的复习

【教学目标】

1. 能正确计算两位数加减法。

2. 能正确计算连加、连减及加减混合两步式题。

【教学重点】

两位数加减法。

【教学难点】

进位加法、退位减法。

【教学成知】

两位数加减法，特别是进位加法与退位减法是一年级第二学期的重要学习内容，这里的主要任务是进行复习。课本以"滑雪"为主题，出示了两条滑道，滑道1是一组两位数减法题，滑道2是一组两位数加法题，让学生饶有兴趣地对两位数加减法进行复习。

【教学建议】

1. "滑雪"。

题1创设了滑雪场的主题，主要复习两位数加减法。教师可以在教学中通过多媒体工具，使学生进入"滑雪"的情景之中，要求学生两个滑道中的计算都要完成，可以鼓励学生思考哪一个滑道中的计算较容易，因而较快地到达终点。

2. 复习关于两位数加减法的两步计算式题：连加、连减、加减混合。

题2-4就加减两步计算式题的三种情况——连加、连减、加减混合进行了复习。

在同级运算中，从左到右依次计算的运算顺序是一种规定，复习时要强调。

学生在做题时，如果有的学生没有按照从左往右的运算顺序进行计算而引发错误时，教师应进行具体指导。

例如题3的第一小题"100-50-50"，如果有的学生是通过"100-(50-50)=100-0"来进行计算，教师应及时纠正学生的错误，并指明必须按照从左向右的运算顺序进行计算。

8

正数和负数

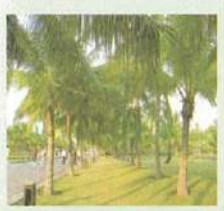
1. 相反意义的量.

生活中有很多具有相反意义的量.

例如:

1

下面的温度计上分别显示了海口与哈尔滨冬季某一天的最低气温.



这一天海口的最低气温是零上 12℃, 哈尔滨的最低气温是零下 25 ℃.

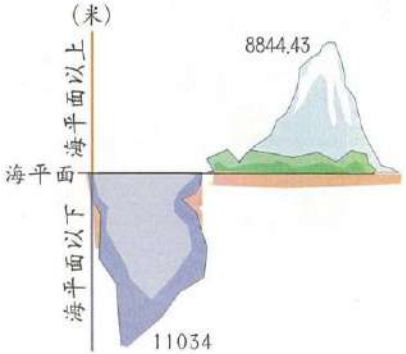
℃ 读作摄氏度.

零上 12℃ 比 0 ℃ 高 12℃ , 零下 25℃ 比 0 ℃ 低 25℃ .

零上温度和零下温度是一对具有相反意义的量.

2

世界第一高峰珠穆朗玛峰大约比海平面高 8844.43 米. 地表的最低点在北太平洋西部的马里亚纳海沟, 据目前测到的深度, 比海平面低 11034 米.



Emphasis on math from context

Sample*: Positive number and negative number copied from Grade 5 textbook*

Math in Real Life

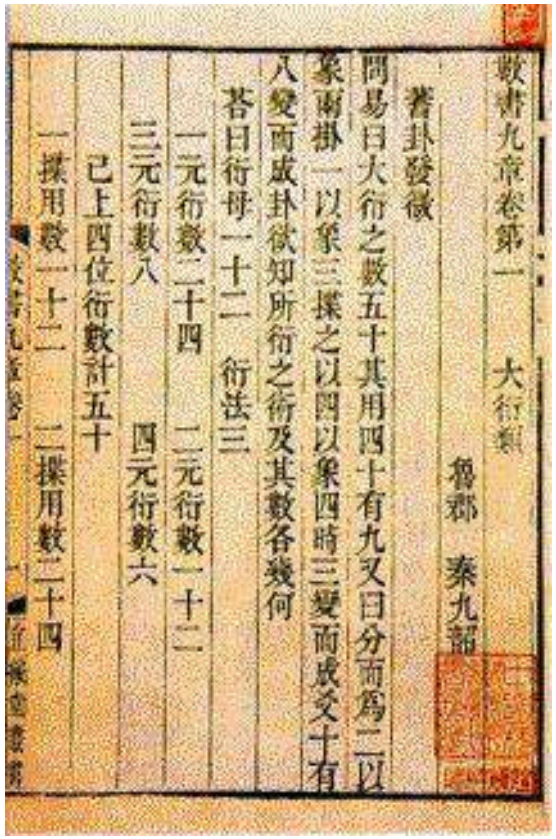

九章算術序

昔在包犧氏始畫八卦以通神明之德以類萬物之情作九
之術以合六爻之變暨於黃帝神而化之引而伸之於是建歷
紀協律呂用精道原然後兩儀四像精微之氣可得而效焉記
稱蒙首作歌其詳未之聞也按周公制禮而有九數九數之流
則九章是矣往者暴秦焚書經術散壞自時厥後漢北平侯張
蒼大司農中丞耐壽昌皆以善算命世蒼等因舊文之遺殘各
刪剟補故校其目則與古或異而所論者多近語也徵幼習九
章長再詳覽觀陰陽之割裂總算術之根源探賾索隱遂悟其
意是以敢竭頑魯採其所見爲之作注事類相推各有攸歸故
枝條雖分而同本幹者知發其一端而已又所析理以辭解體
用圖席亦約而能周通而不黷覽之者思過半矣且算在六藝

九章算术

“Nine Chapters on Mathematical Art”

- Used for 2,000 years, till about 1600
- Covered practical topics, e.g.,
  - Chapter 1: Fields
  - Chapter 2: Millet and Rice


數書九章卷第一　大衍類

魯郡　秦九韶

蓍卦發微

問易曰大衍之數五十其用四十有九又曰分而爲二以
象兩掛一以象三揲之以四以象四時三變而成爻十有
八變而成卦欲知所衍之術及其數各幾何

荅曰衍母一十二　衍法三

一元衍數二十四　二元衍數一十二

三元衍數八　四元衍數六

已上四位衍數計五十

一揲用數一十二　二揲用數二十四

数书九章

“Mathematical Treatise on Nine Topics”

- Compiled in 13th century
- 18 volumes, also on practical topics, e.g.,
  - Topic 1: Estimation
  - Topic 2: Seasons and Weather

14

第 3 节　等腰三角形

14.5　等腰三角形的性质

图14-36

我们知道，等腰三角形有两条边相等．如图14-36，$\triangle ABC$ 是等腰三角形，$AB=AC$．这时，边 AB 和 AC 是它的腰，BC 是底边；$\angle A$ 是它的顶角，$\angle B$ 和 $\angle C$ 是底角．下面，我们来研究等腰三角形两个底角的大小关系．

问题

等腰三角形的两个底角具有怎样的大小关系？

操作

在纸上画一个等腰三角形 ABC，其中 $AB=AC$，再画出顶角的平分线 AD，设 AD 与 BC 相交于点 D（图14-37）．

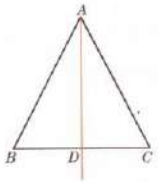


图14-37

图14-38

想一想，这样的翻折说明等腰三角形具有怎样的对称性？

把 $\triangle ABC$ 纸片剪下，将 $\triangle ABD$ 沿着直线 AD 翻折．

因为 $\angle BAD=\angle CAD$，所以将 $\triangle ABC$ 沿着 AD 翻折后，射线 AB 与射线 AC 叠合．由于 $AB=AC$，因此线段 AB 与线段 AC 重合，于是点 B 与点 C 重合．又因为点 D 与点 D 重

Emphasis on mathematical reasoning

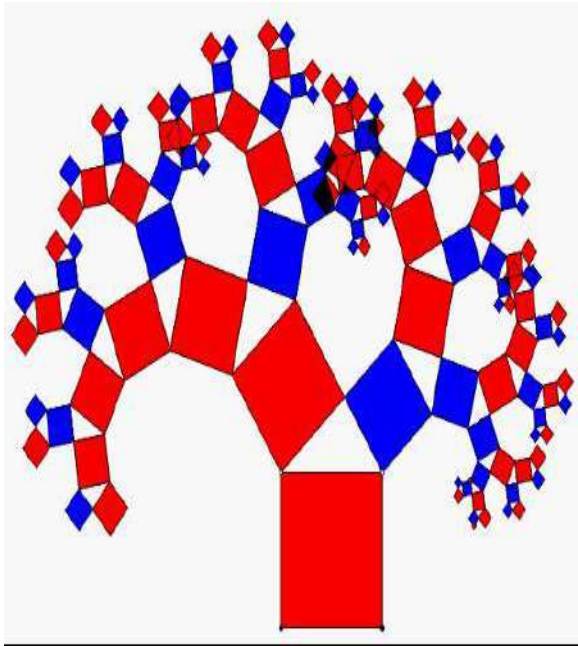
Sample*: Isosceles triangle copied from Grade 7 textbook*

Euclid’s Elements

Euclid（BC330-BC275）

徐光启
XU, guangqi（1562-1633）

Math Teacher



Teacher Profile

- Strong grasp of mathematics
- Professional skills to teach mathematics in school:
  - Plan lessons
  - Conduct lesson in class
  - Mark homework
  - Mentor students
  - Evaluate students' progress in learning

Teacher Development

- Stronger system for professional development
  - Organized structures for discussion and sharing of experiences:
    - Math teaching research group
    - Lesson planning group
  - Systematic mentoring of new or junior teachers
  - On- and off-campus teaching and research activities:
    - Lesson observation
    - Lesson explanation
    - Lesson evaluation

Math Teaching

Instructional Model: Demonstration

- Russian-inspired
- Main instructional model till the 1980s

- Model's 5 typical parts:
  - Introduction or Review
  - Teaching of new topic
  - Practice to consolidate knowledge
  - Summary of lesson
  - Homework assignment

（N.A.Kaiipob,1893-1978）

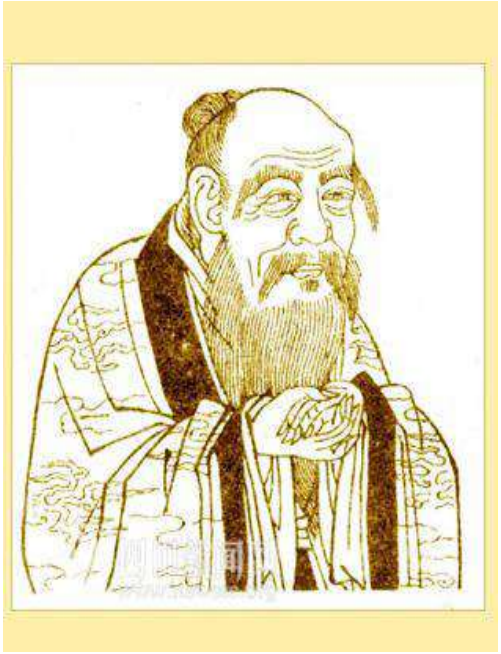
Instructional Model: From One to Many

Math Lesson

- Structured
- Orderly
- Coherent
- Complete

Teaching: Look for Balance

- Aligns with China's traditional philosophy



Lao Tzu
(About 570 BC)

Confucius
(551~479 BC)

Memorization & Understanding

- **Memorization is the foundation for understanding**
- **Leading understanding from memorization**
- **Understanding promotes memorization**

Prof. ZHANG, Dianzhou

Multiplication

```
 1 2
x 23
-------
  36
24
__ __
276
```

1. Why move “24” forward?
2. No idea. But I did it right!

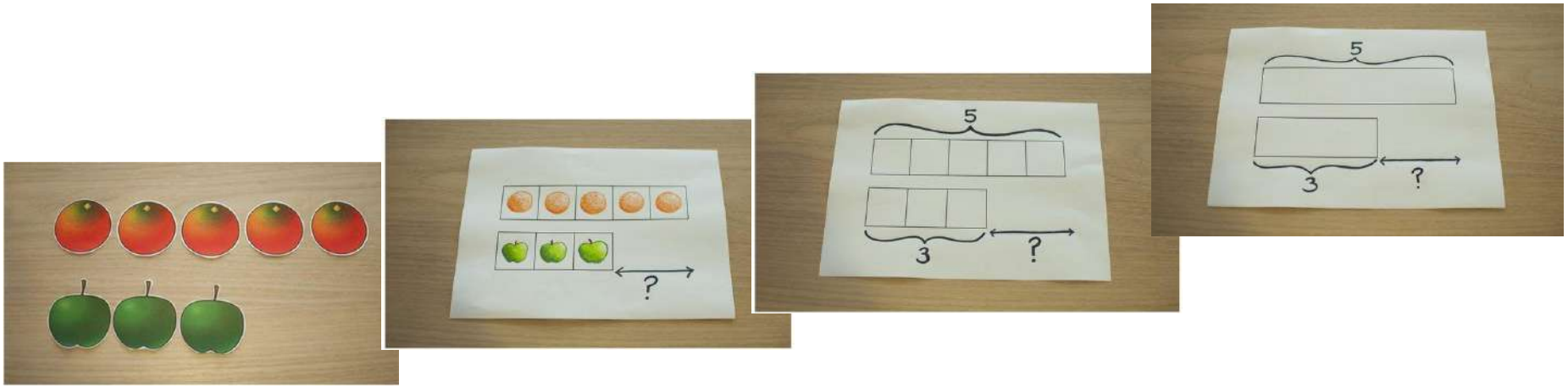
……

3. Finally I realized one day.

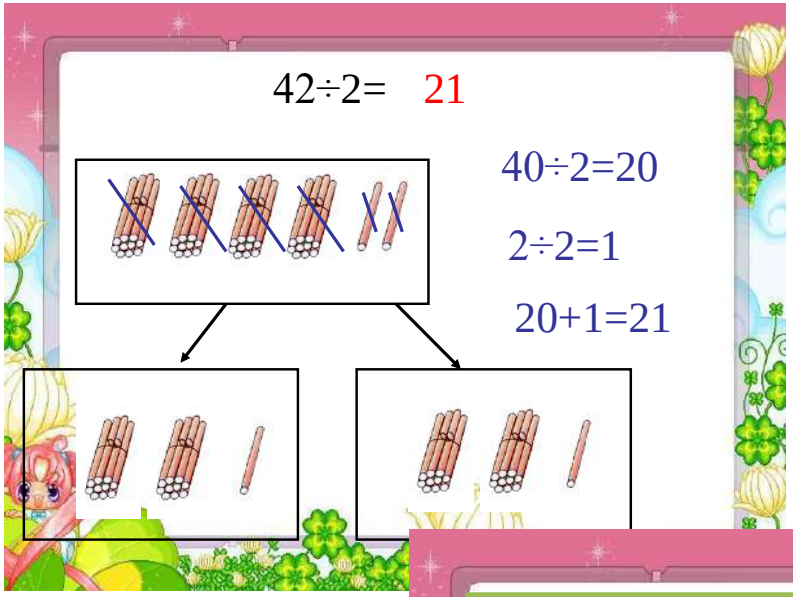
12x23=12x(3+20)=12x3+12x20=36+240=276

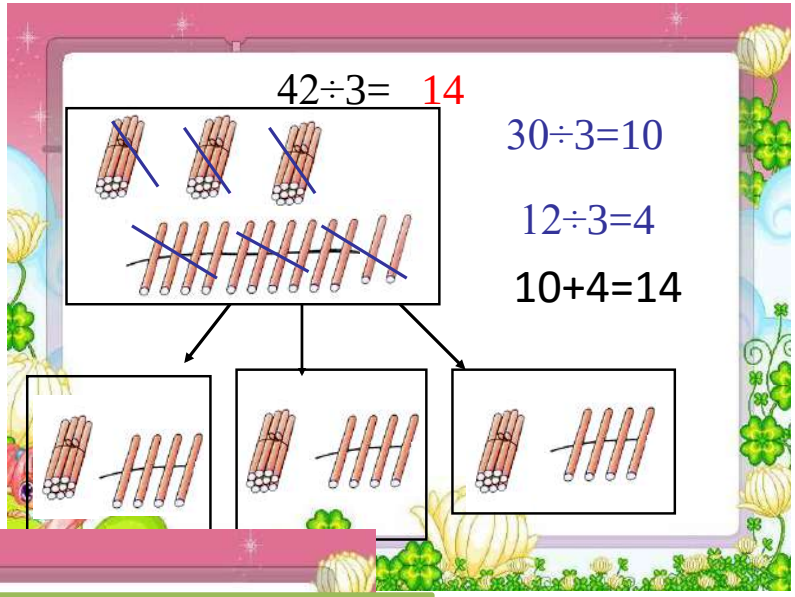
Concrete & Abstract

- Concrete and abstract are two aspects of mathematics
  - Concrete is easy to understand, but
  - Abstract is the only way to generalize ideas



From Manipulation to Algorithm
(From Mrs. Wu)





Row calculation

7 ÷4= 7 ……3

40÷4= 0

3 ÷4=7 ……3

Columnar calculation

$$\begin{array}{r} 7 \\ 4\overline{)\,7} \\ \underline{4} \\ 3 \\ \underline{2\ 8} \\ 3 \end{array}$$

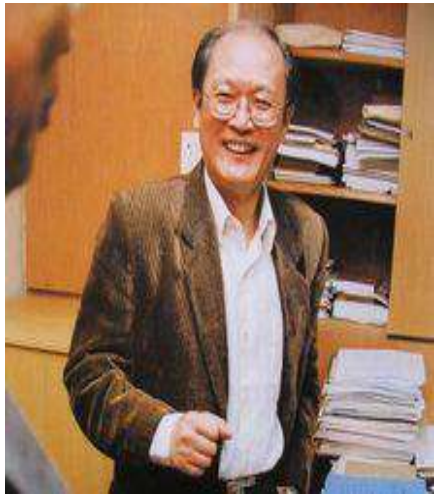
… 0×4

…7×4

3e0ai1de3

Diversifying Teaching Strategy

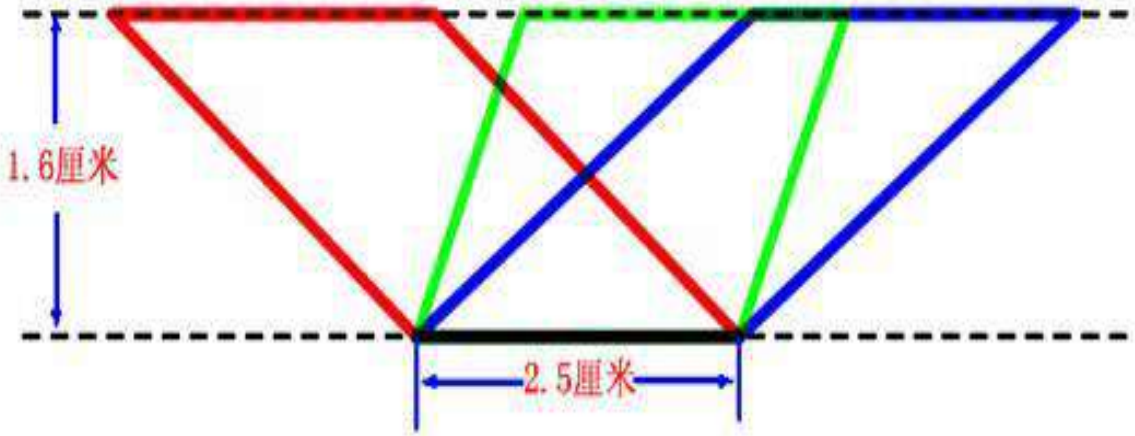
- Conceptual variation:
  - Change non-essential properties of a concept, thus highlighting its immutable property.
- Procedural variation:
  - Start from simple questions, resolve similar and related problems by changing conditions.
    - Multiple solutions to an exercise
    - Multiple questions to an exercise
    - Multiple variation to an exercise

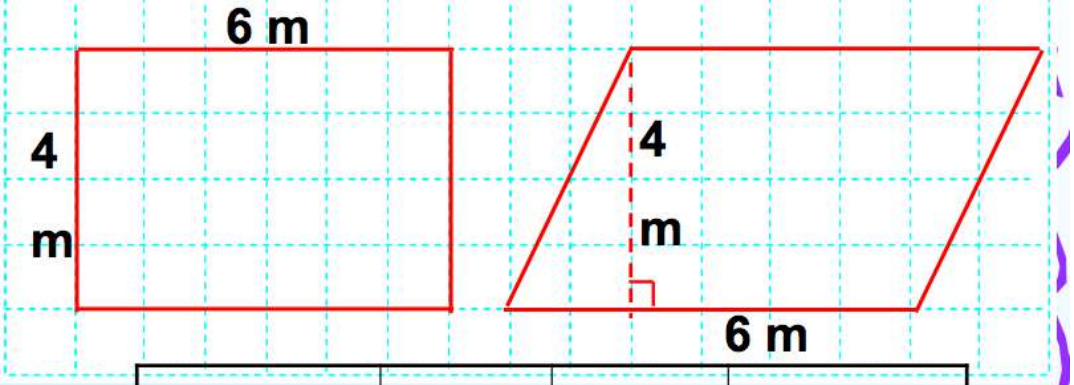


Prof. GU, Lingyuan

A Case of Parallelogram Area

(A lesson designed by Mrs. Gan)

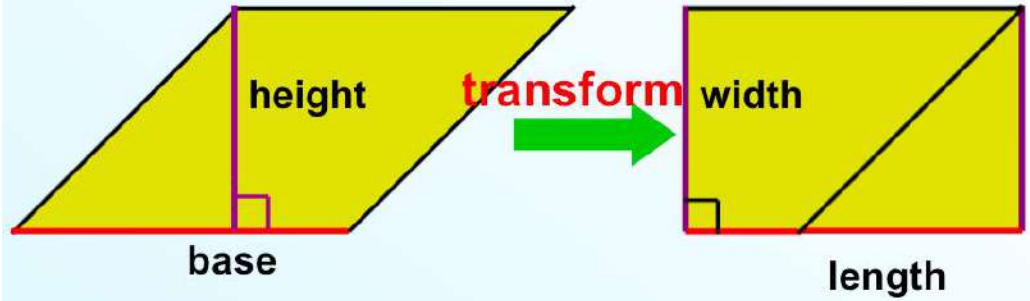


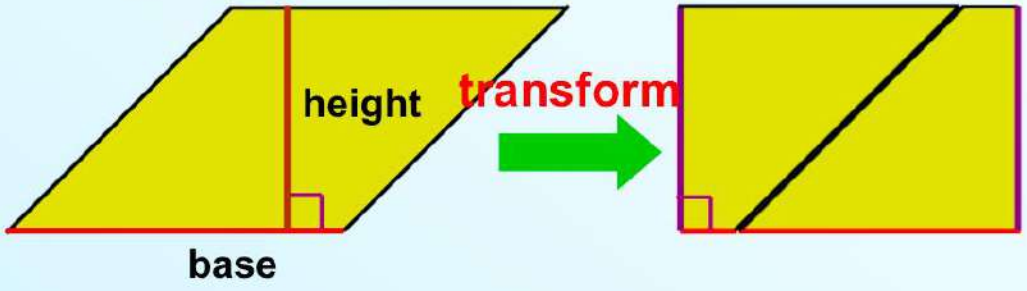


rectangle	length	width	area
	6m	4m	$24m^2$
parallelogram	base	height	area
	6m	4m	$24m^2$

Figure changes, area same

Position changes, figure same





Do you know another method?

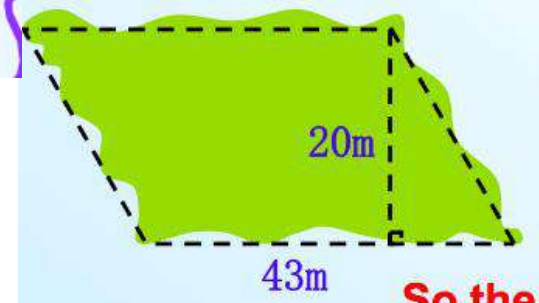
Area of a rectangle **transform** Area of a parallelogram

Area of a rectangle = Length × Width

Area of a parallelogram = Base × Height

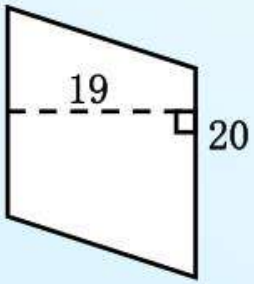
Method changes, conclusion same

Situation changes, formula same



S = a h
=43×20
=860 (m)

So the area of the grass is about 860 m .



S = a h
= 20×19
= 380 (cm²)

So the area of the parallelogram is 380 cm .

Classroom Interactions

- **Most effective: Teacher Demonstrating & Student Exploring**

Teachers

Not advisable:

- If only teacher talks or does not talk at all

Good practice:

- Ask questions, elicit and listen to answers
- Use heuristic strategy
- Provide interpretation, feedback

Students

Not advisable:

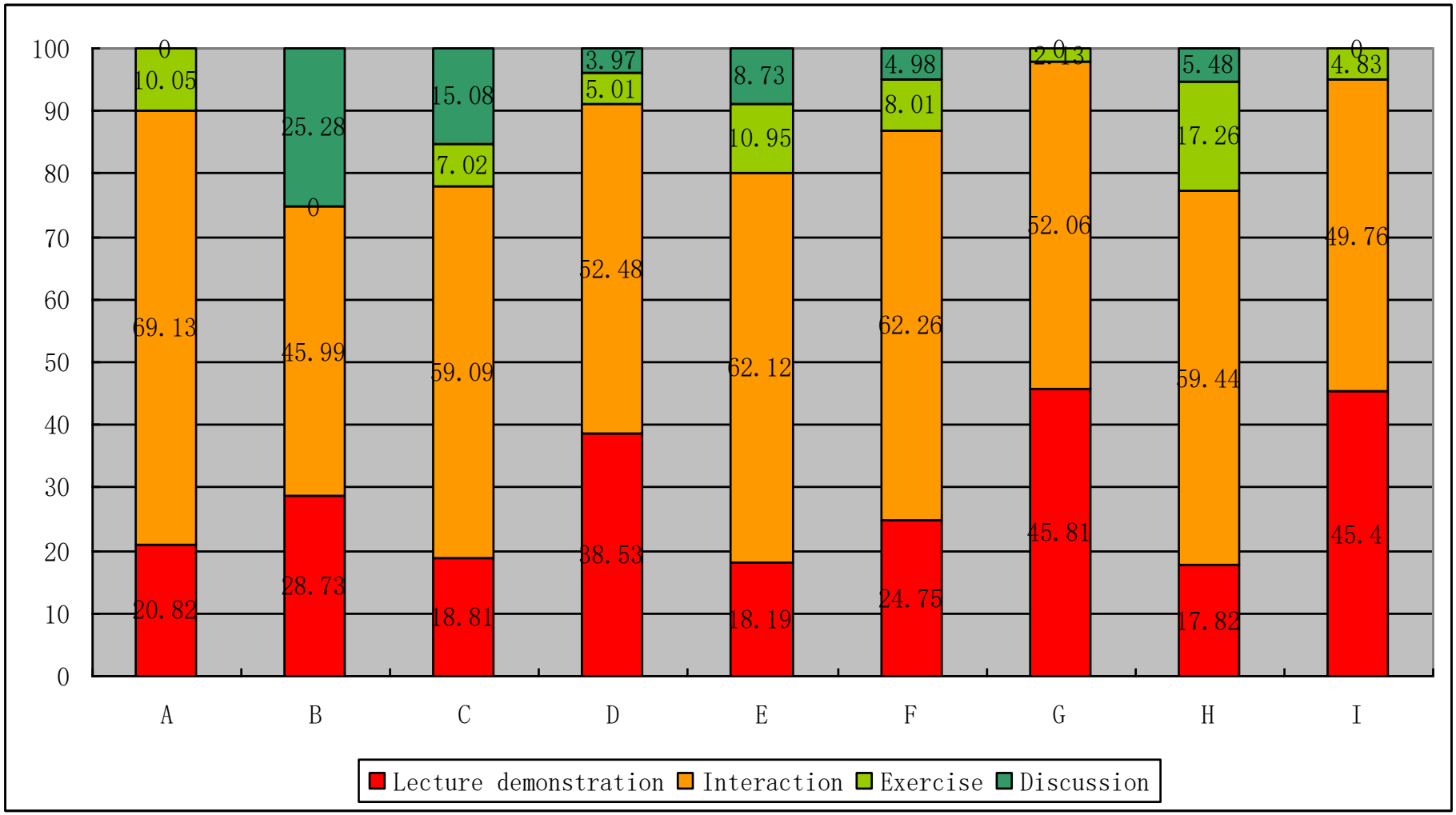
- If left to explore entirely on their own
- If they don't participate at all

Good practice:

- Answer questions in class, explore, communicate, demonstrate, discuss
- Think deeply, reflect

Main Classroom Activities in Shanghai Math Lessons:

Prominence of Interaction Time



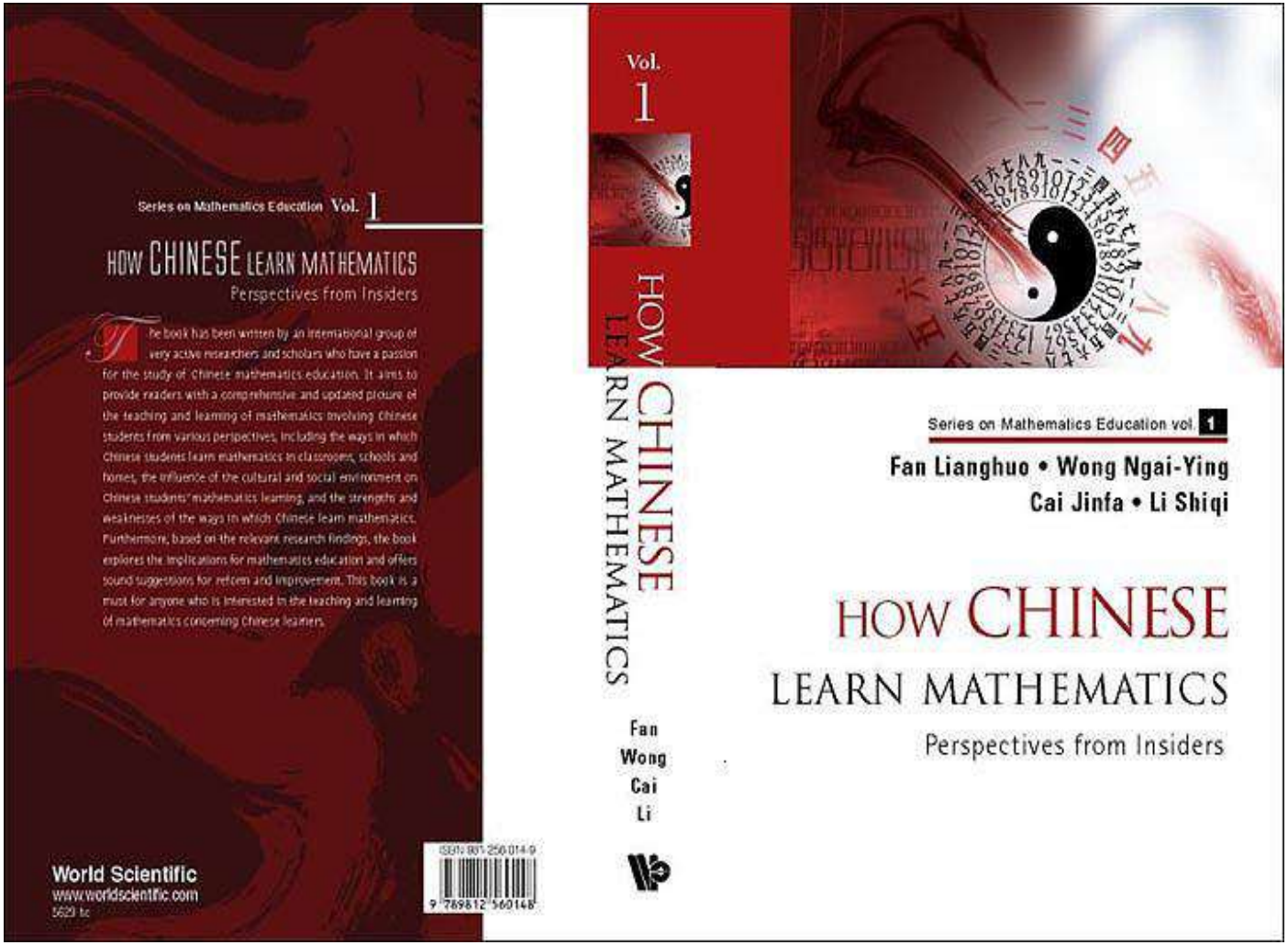
Source: data from my PhD thesis, ECNU, 2008)

Mastery: Going Forward Step by Step

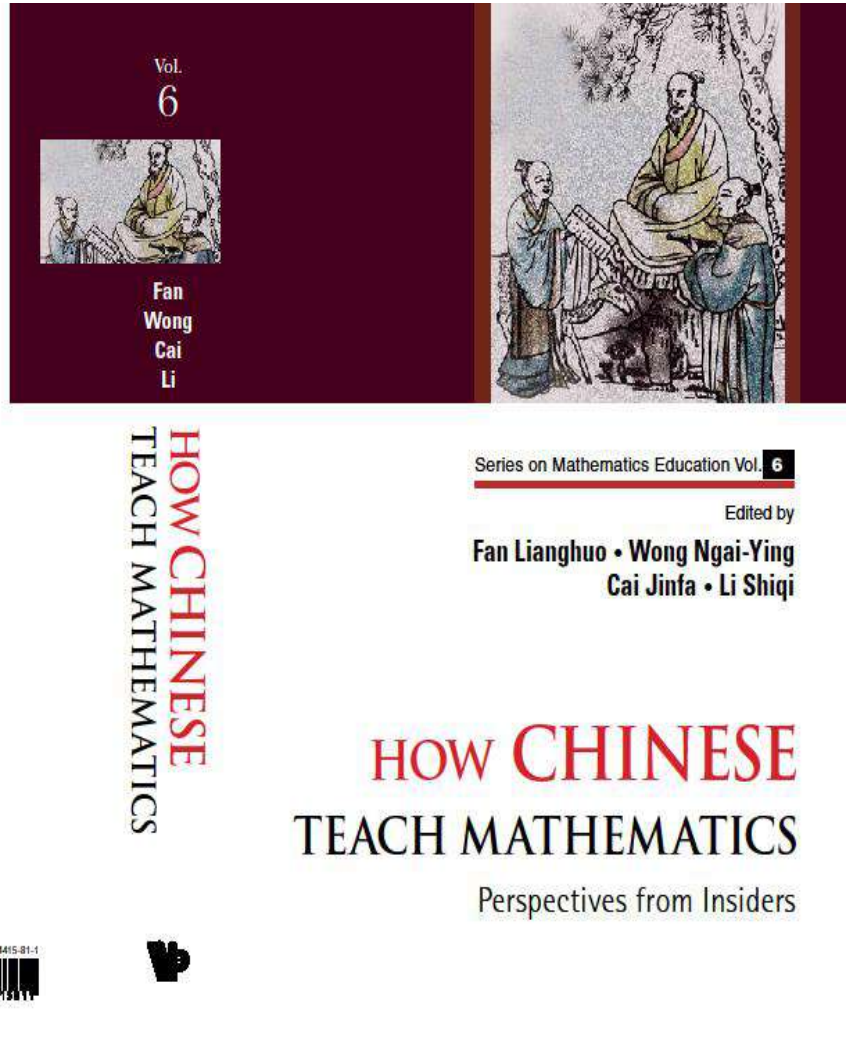
Concluding Remarks

- Shanghai mathematics education is not perfect
- The way forward involves:
  - Seeking a balance between tradition and transformation
  - Continuous reform to address deficiencies

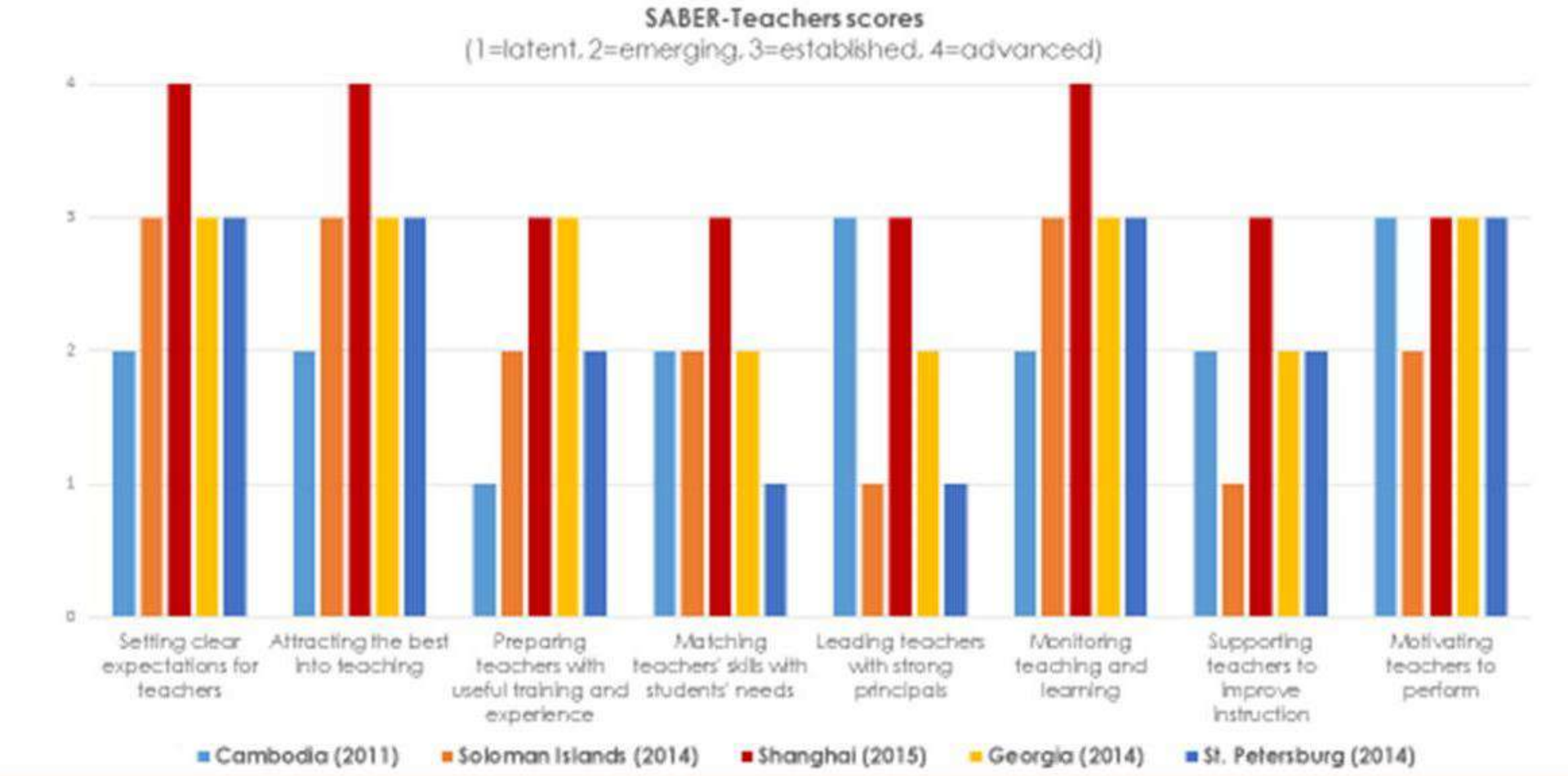
How Chinese Learn Mathematics: Perspectives from Insiders



How Chinese Teach Mathematics: Perspectives from Insiders



Thank you so much



ATTRACTING AND DEVELOPING AN EXCELLENT TEACHING FORCE

TEACHING RESEARCH SYSTEM IN CHINA

Mostly school-based, and focus on Improving Instruction

- Lesson preparation
- Professional development
- Coaching and guidance
- Induction of new teachers
- Subject content and pedagogy
- Lesson observations
- Student interactions
- Grade homework
- Teacher performance evaluation