

# A Study of the Relations between Teachers' Belief System and Their Practice of Modeling Teaching in Mathematics Classrooms

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# A study of the relations between teachers' belief system and their practice of modeling teaching in mathematics classrooms

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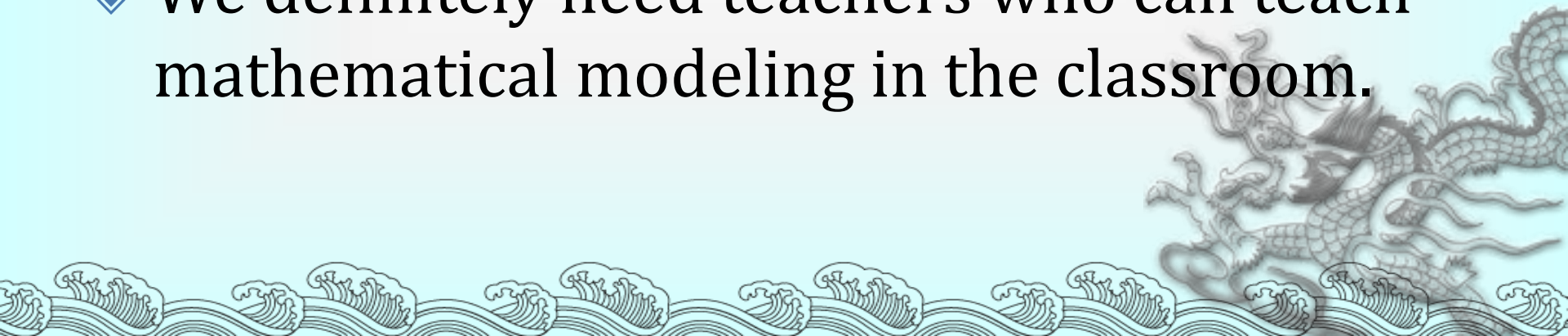
# Background-1

- ◆ We are in a rapidly changeable world and will face problems much more complicated than before.
- ◆ Our students need to learn how to create new knowledge in order to solve tough problems in the future.



# Background-2

- ◆ Also, international assessment, such as PISA, started to emphasize students' modeling competency more and more.
- ◆ Therefore, the transform of mathematics instruction from lecture teaching to modeling teaching is necessary.
- ◆ We definitely need teachers who can teach mathematical modeling in the classroom.





# Background –3

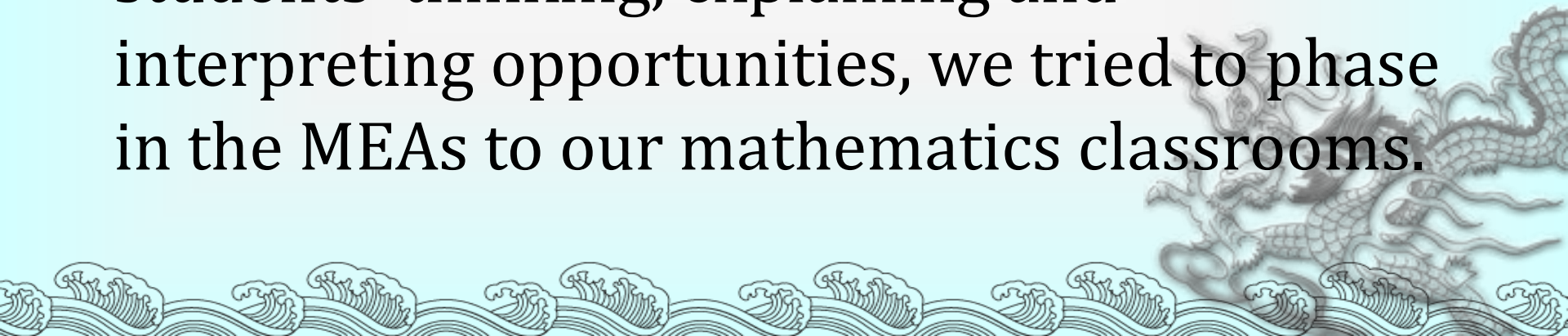
## TRADITIONAL LECTURE

- ◆ Lack of thinking by themselves
- ◆ Emphasize calculation
- ◆ Memorize the formula and didn't know how and why



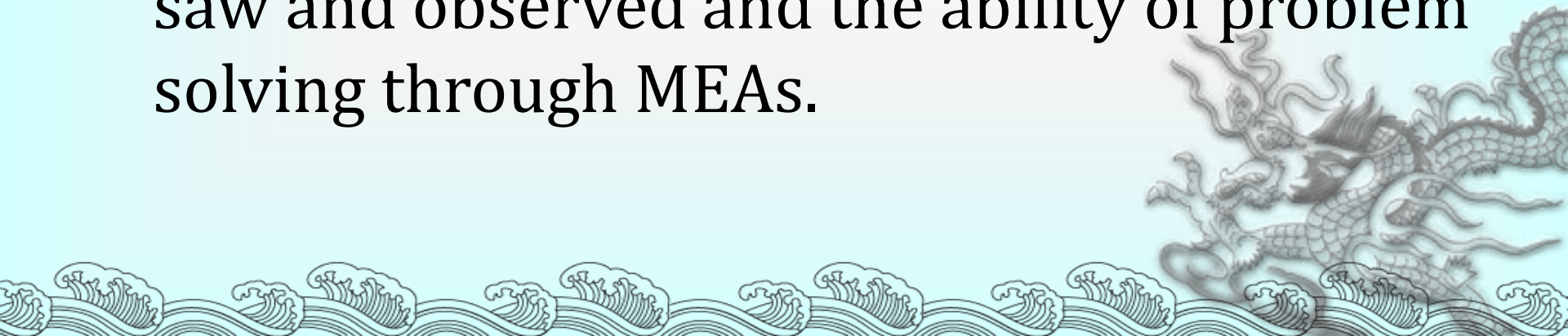
# Background-4

- ◆ Researches emphasized more and more on the issues of enhancing students' mathematical competency recently in mathematics education (Niss, 2003; Lesh & Zawojewski, 2007).
- ◆ In order to amend the condition and promote students' thinking, explaining and interpreting opportunities, we tried to phase in the MEAs to our mathematics classrooms.



# Background-5

- ◆ The crucial reason we used modeling activities was that in such activities students have to describe, manipulate, predict and verify (Lesh & Doerr, 2003).
- ◆ We hoped that students could enhance the descriptions and interpretations of what they saw and observed and the ability of problem solving through MEAs.



# Background-6

Students engaged in Model-Eliciting Activities (MEAs)

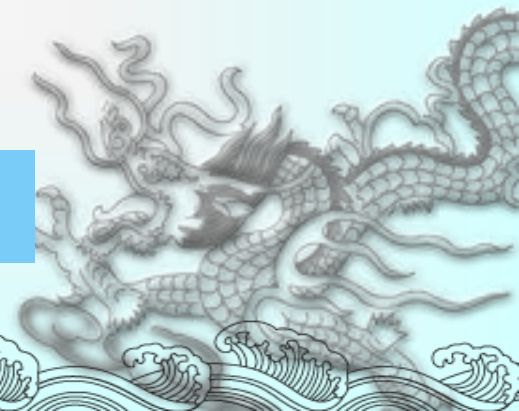


Teachers' instruction



influence

Teachers' belief system





# Main idea of my study

Teachers'  
mathematical  
modeling  
teaching

**Relations**

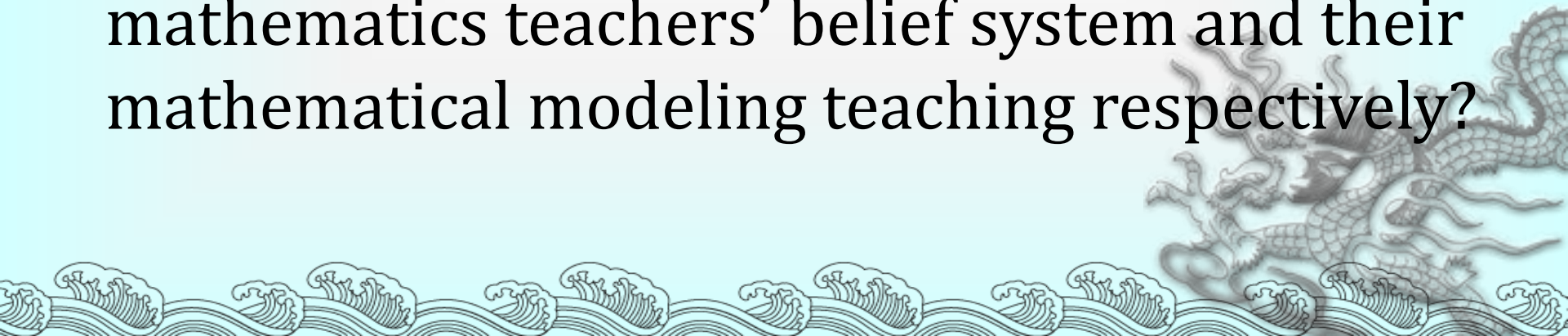


Mathematics  
teachers'  
belief system

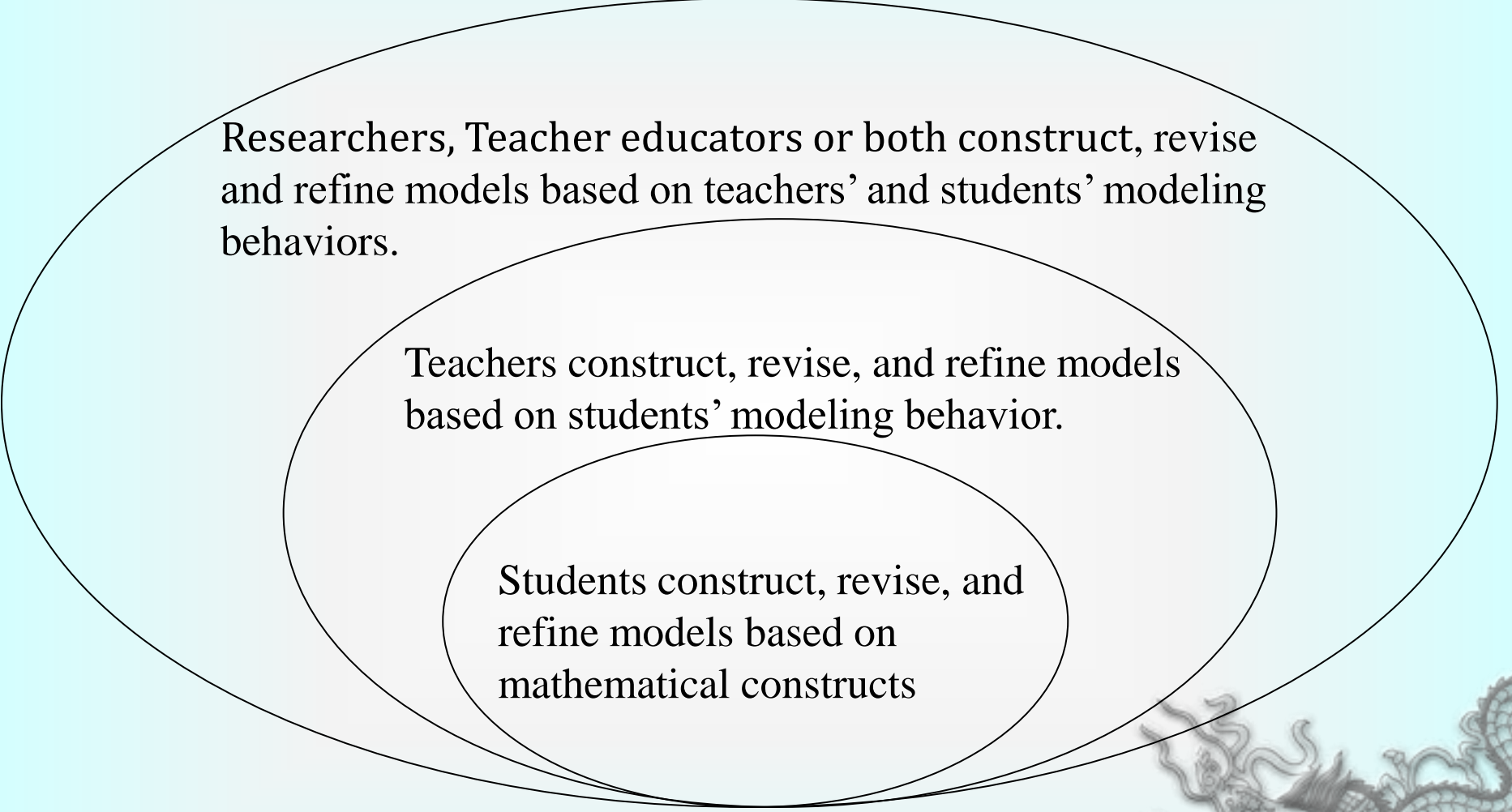


# Study questions

- ◆ First, what are the characteristics of mathematical modeling teaching of these teachers respectively?
- ◆ Second, what are the mathematics teachers' belief systems of these teachers respectively?
- ◆ Third, what are the relations between the mathematics teachers' belief system and their mathematical modeling teaching respectively?



# Study design-1



Researchers, Teacher educators or both construct, revise and refine models based on teachers' and students' modeling behaviors.

Teachers construct, revise, and refine models based on students' modeling behavior.

Students construct, revise, and refine models based on mathematical constructs

Multitier program development (Clark & Lesh, 2003)



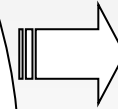
# Study design-2

Tier	This study
Researchers	Researchers attempt to modify MEAs with teachers, and encourage teachers to implement MEAs in their math class. They also provide support and help to teachers, so that teachers can gradually realize what is modeling teaching. In addition, teachers analyze students' data with researchers and at the same time, researchers get the data of teachers' belief system in the process.
Teachers	They try to implement model-eliciting activities (MEAs, Lesh & Doerr, 2003) in their math class and also attempt to modify MEAs into Taiwan version or adapt problems in the text book into MEAs
Students	Students solve MEAs in groups with three or four persons, develop problem solving strategies, and reveal their thinking process.

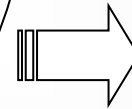


## Teacher level thought-revealing activity

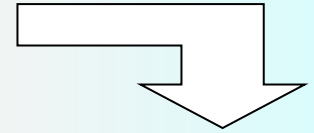
- Complete student level thought-revealing activity
- Examine mathematical ideas inherent in activity
- Observe students solving activity
- Discuss assessment and evaluation of the activity
- Create conceptual tools
- Engage in purposeful reflection
- Develop case study



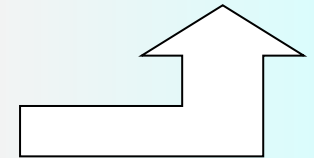
Mathematical  
content  
knowledge



Understanding  
of how  
children learn  
math



Effective  
instructional  
decisions



Student level thought-  
revealing activity

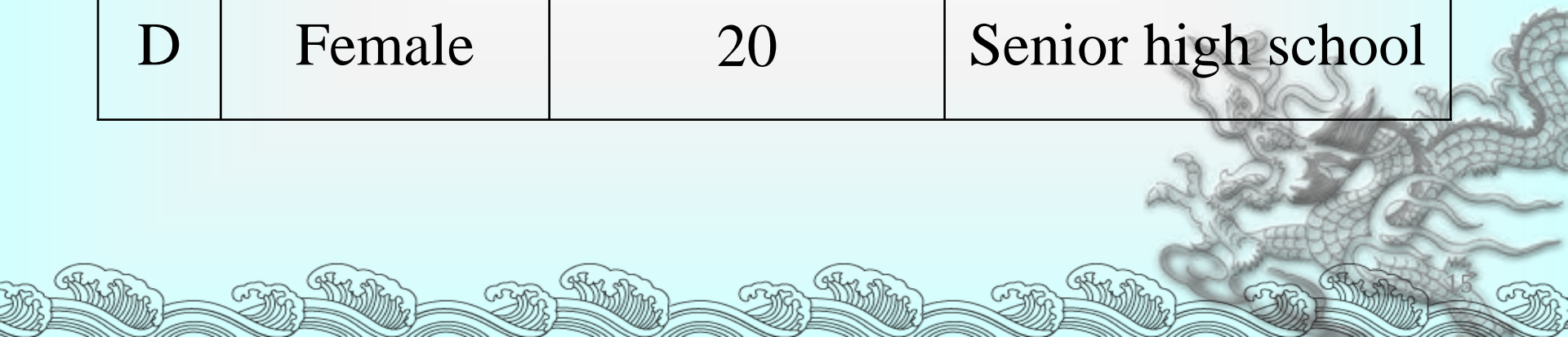
A model for teacher development. (Schorr & Lesh, 2003)

Theoretical	Practical activity in my study
Student level thought-revealing activity	Students engage in thought-revealing activity with teachers' guidance, and thought-revealing activity means MEAs
Examine mathematical ideas inherent in activity	Researchers and teachers discuss the mathematical concepts in MEAs and mathematical knowledge or competency that students reveal
Observe students solving activity	Teachers develop observation forms to record students' performance and understand students' thinking and learning in solving MEAs
Discuss assessment and evaluation of the activity	Discuss how to assess students' solutions and evaluate the quality of their model. Develop appropriate forms and ways to complete assessments.
Create conceptual tools	Researchers and teachers collaboratively create conceptual tools according to study purpose respectively.
Engage in purposeful reflection	Researchers and teachers engage in writing purposeful reflection journal according to study issues respectively.
Develop case study	Researchers and teachers complete their own dissertation.



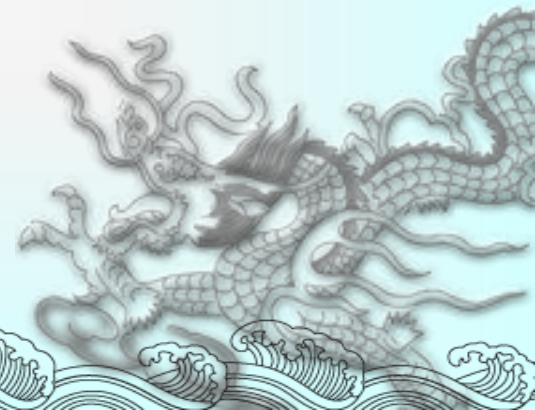
# Methodology-participants

	Gender	Teaching years	School level
A	Male	6	Senior high school
B	Female	4	Senior high school
C	Female	17	Senior high school
D	Female	20	Senior high school



# Methodology-data collection

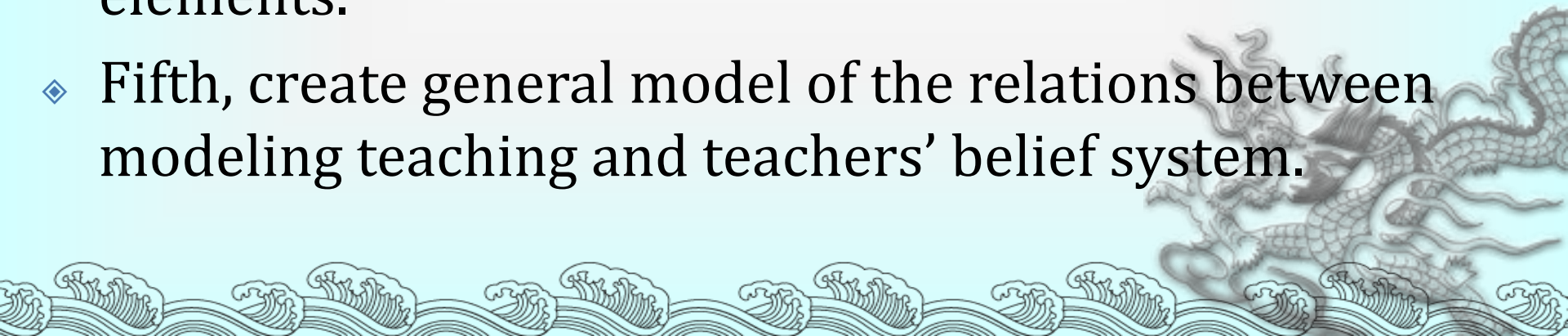
- ◆ collect **multiple dimension** of data
  - the learning sheets that showed teachers' strategies of MEAs
  - the results of the MEA they revised or designed,
  - classroom observation journals,
  - reflection journals,
  - questionnaires,
  - interview reports,
  - video tapes of the meetings
  - video tapes of the classes.





# Methodology-data analysis

- ◆ **Grounded Theory.**
- ◆ First, reorganize all data to open coding.
- ◆ Second, extract related characteristics of modeling teaching and teachers' belief system.
- ◆ Third, categorize these characteristics in order to code the key elements.
- ◆ Fourth, structure the relationship among these elements.
- ◆ Fifth, create general model of the relations between modeling teaching and teachers' belief system.

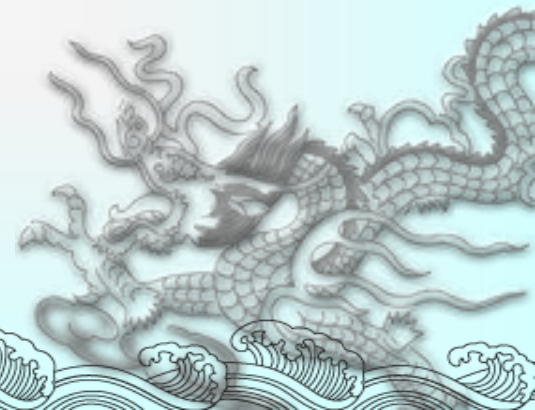


**Thank You for your attention!**



# Mathematical modeling teaching

- ◆ 1) Newspaper article
- ◆ 2) Readiness problems
- ◆ 3) Problem statement
- ◆ 4) Process of sharing solutions



Object  
(mathematics education)

Teachers'  
Mathematics-  
related Belief  
system

Context  
(class)

Self



The dimension of Teachers' Mathematics-related Belief  
system



# MODEL DEVELOPMENT SEQUENCES

☆The instruction of the study adopted the model development sequences (showed as figure 1.)

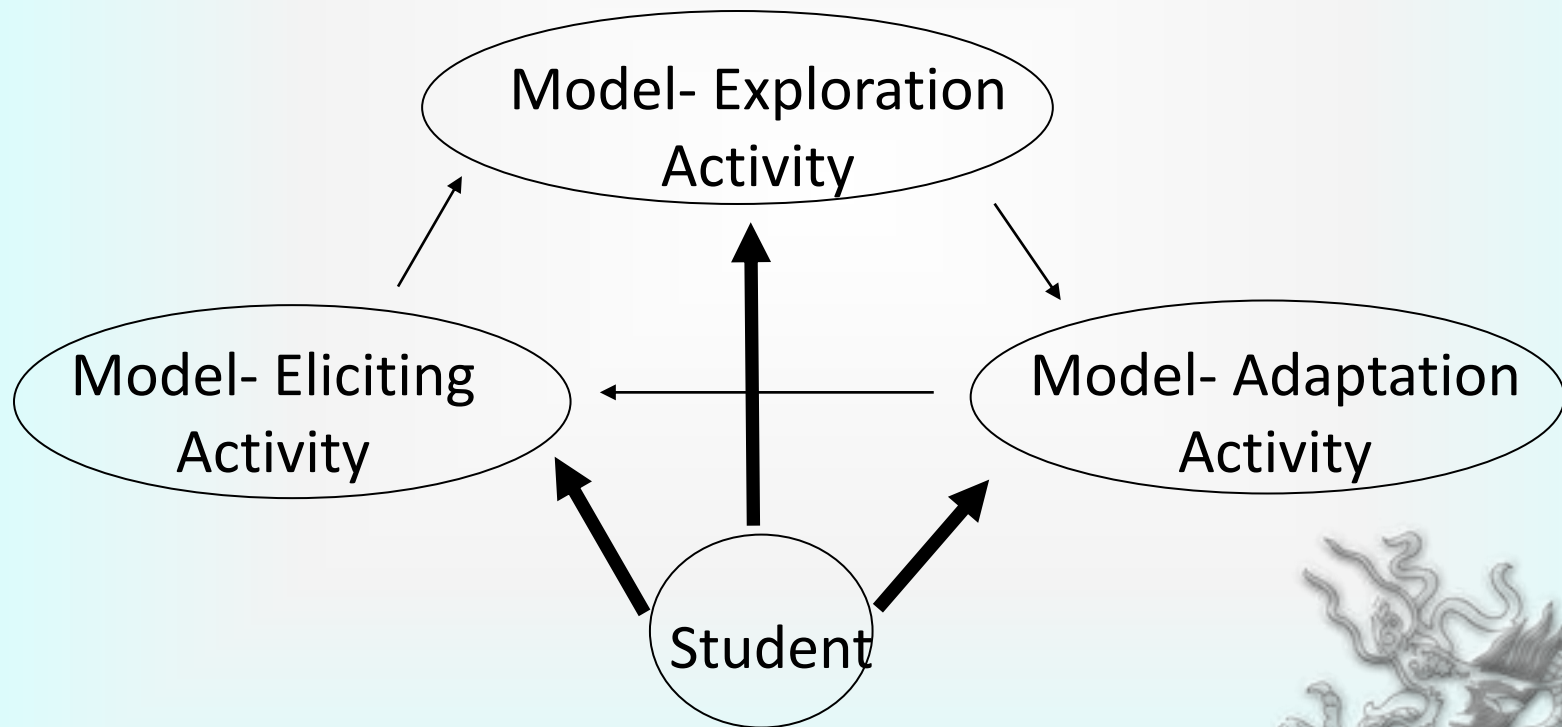
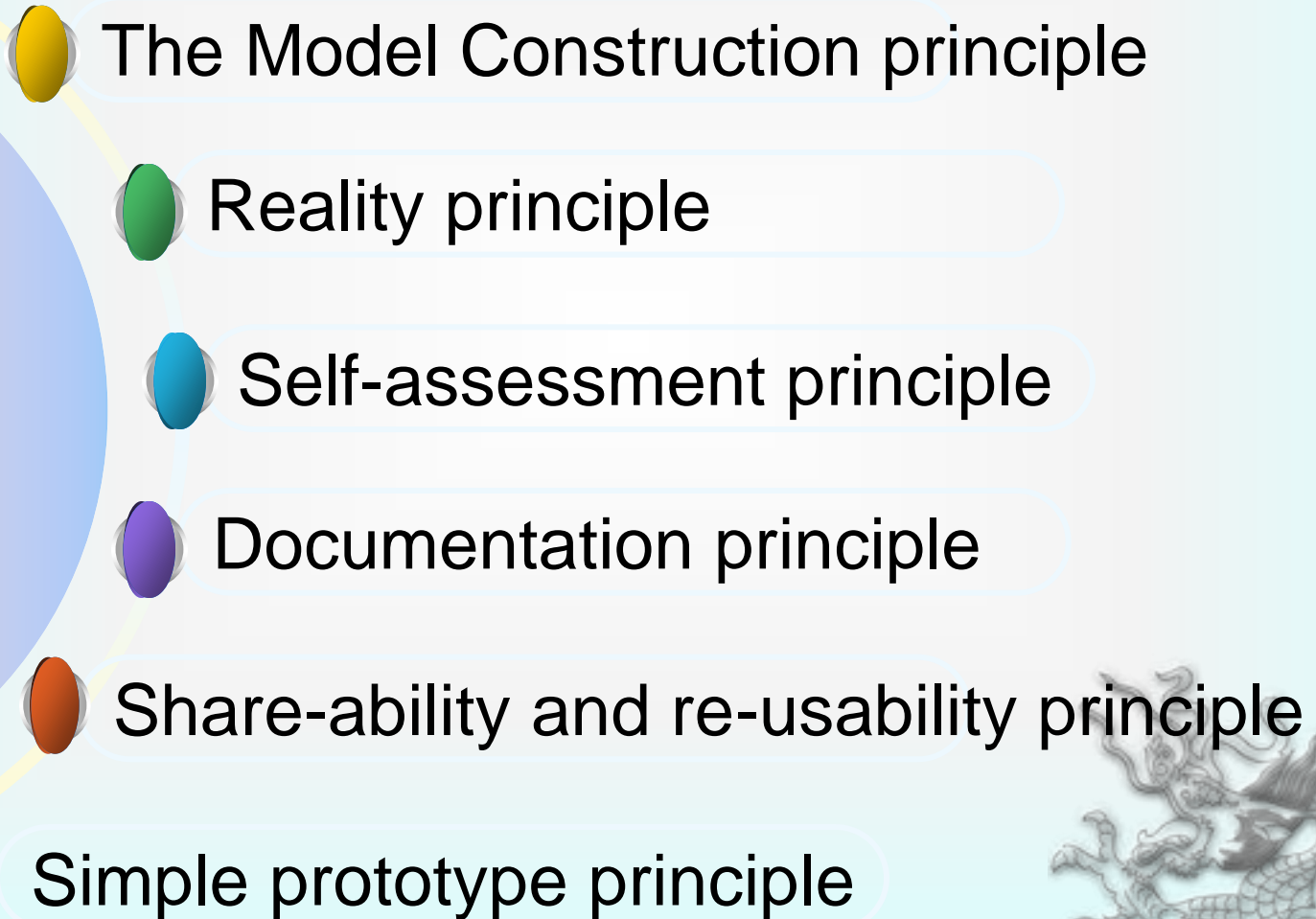
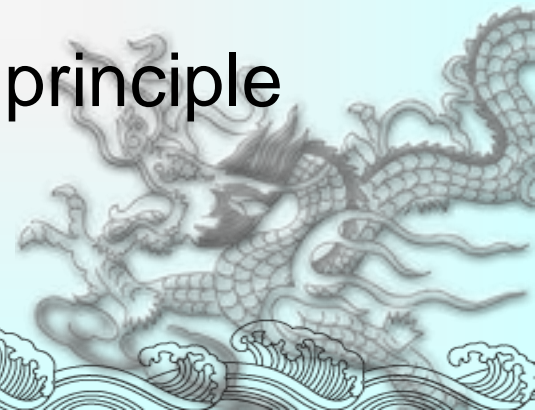


Figure 1. Model development sequences (Lesh & Doerr, 2003, p.40)

# SIX PRINCIPLES OF DESIGNING MODEL-ELICITING ACTIVITY (Lesh & Doerr, 2003)

- 
- The Model Construction principle
  - Reality principle
  - Self-assessment principle
  - Documentation principle
  - Share-ability and re-usability principle
  - Simple prototype principle



# “WHO SAVED THE ORIENTAL CHERRY TREES?”



There are many oriental cherry trees planted in Kuang-Jen junior high school. When the blooming season is coming, blossoms bloom from cherry trees. The campus is so beautiful and is fully around with these cherry trees. However, some trees which were just planted were damaged by the typhoon Ta-Li. Some of them had been killed during typhoon. When teachers and students all sighed for those dead trees, a kind person in mystery replaced all those dead trees by new saplings sometime at one night.



For finding out this nice person, school asked the security guard. “Except for teachers, parents and students in self-study, there were no other people went into campus at that night”, the guard answered. After searching the whole garden, we finally found couple footprints left by this person. We may approximately calculate the figure of this guy and by doing so will help us in finding out this good person in private. Now we only got his footprints. How could we apply this clue to find out this kind person? How will you calculate the figure of this person by his footprints? Why?



**Object(11)**

- a. Learning(4)
- b. Teaching(4)
- c. Nature of mathematics(3)

**TMBS**

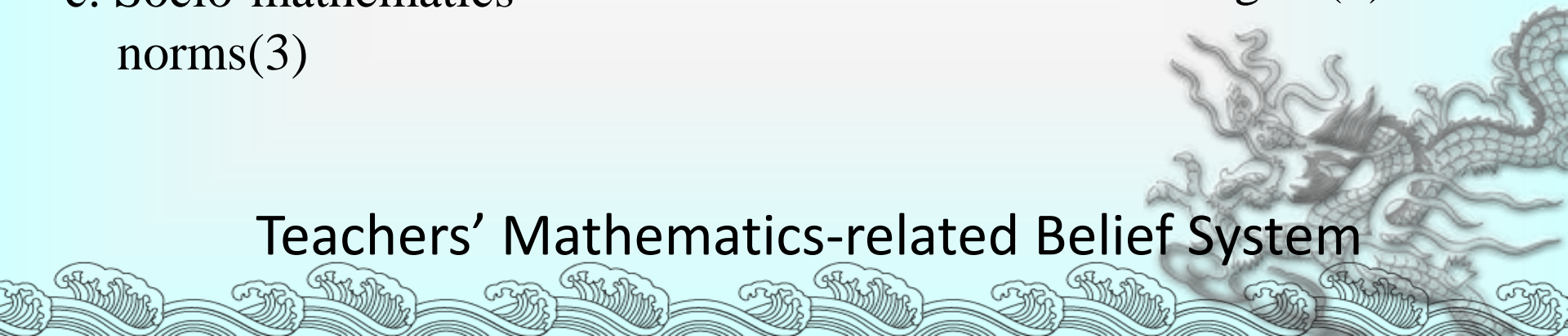
**Context(13)**

- a. Interaction between teacher and students(6)
- b. The role of teacher(4)
- c. Socio-mathematics norms(3)

**Self(15)**

- a. value(5)
- b. Control(5)
- c. self-efficacy and goal(5)

**Teachers' Mathematics-related Belief System**





Subscale	Factors	Example items
Object	Learning	Before learning mathematical concepts, students are like empty vessels and wait teachers to tell them new mathematical knowledge
	Teaching	Cooperative learning isn't an appropriate way for mathematics teaching .
	Nature of mathematics	Mathematical knowledge is the TRUTH which has existed already.



Subscale	Factors	Example items
Self	Value	It wastes time for me to let students discuss with each others in mathematical learning.
	Control	If the scores of the exam are not so important, I can teach mathematics better.
	Self-efficacy and goal	I have confidence that my students understand math deeper than other students.



Subscale	Factors	Example items
Context	Interaction between teacher and students	The conversations between mathematics teachers and students are commands and announcement.
	The role of teacher	Mathematics teachers delivery mathematical knowledge to students.
	Socio-mathematics norms	In my classroom, my students like to discuss mathematical problems with classmates.



# A SIMPLE MODELING CYCLE

