Jones, K. Zheng, Y. & Ding, L. (2009), Developing pedagogic theory: the case of geometry proof teaching. Invited Keynote Paper at the 3rd International Symposium on the History and Pedagogy of Mathematics. Beijing (China), 22-25 May 2009.

Developing Pedagogic Theory: the case of geometry proof teaching 教学理论的研究与发展: 几何证明教学的课例

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Our research …

- compares the teaching of proof in geometry at the lower secondary school level in the East (China, Japan) and in the West (UK)
- seeks to identify teaching strategies that might inform new pedagogic approaches for teaching deductive proof and proving

Pedagogy, proof and proving

What is known:

- teaching is an activity that is strongly influenced by the wider cultural setting of a nation;
- in addition to wider cultural factors, teaching is influenced by specific educational issues such as the specification of the mathematics curriculum, the design of textbooks, and the demands of examinations

The result is that most teachers in a particular country seem to do things in fairly similar ways.

Geometry proof teaching: a case

This case is available as:
Ding, L. & Jones, K. (2009). Instructional strategies in explicating the discovery function of proof for lower secondary school students. Paper presented at *ICMI study 19 on proof and proving*, Taipei, Taiwan, 2009.

http://ocs.library.utoronto.ca//index.php/icmi/

Geometry proof teaching: a case

Case details from Shanghai City:

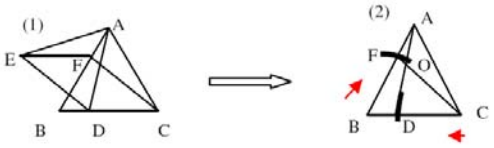
- Grade 8 class on deductive geometry
- Class size around 40 students (mixed-attainment)
- Shanghai City Standard Examination at Grade 9

Geometry proof teaching: a case

Proof problem presented to class:

Given: triangles ABC and AED are equilateral; CD=BF.

Prove: 1) triangles ADC and CFB are congruent; 2) quadrilateral CDEF is a parallelogram.



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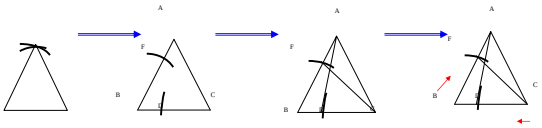
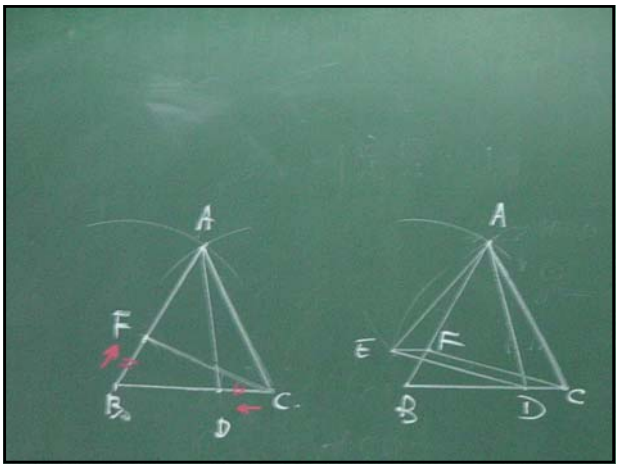
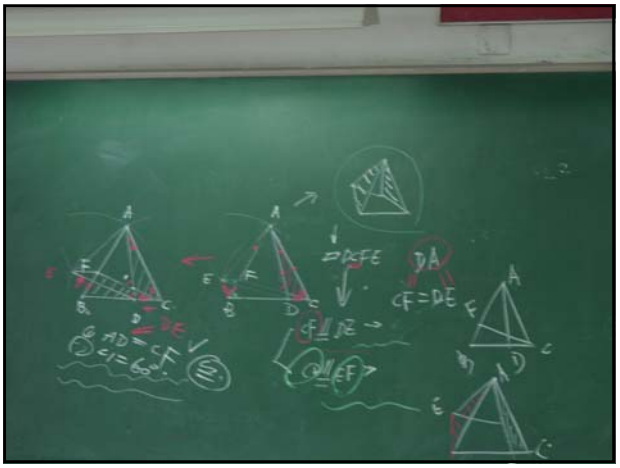
Geometry proof teaching: a case

Teacher: D and F are dynamic points…they move such that CD=BF. So if D goes this way. F goes that way. …







Geometry proof teaching: re-analysis

Details can be found in the paper for the Beijing conference:

Teaching geometrical proof problem solving in China: a case analysis from the perspective of the dynamic approach of the teacher

Geometry proof teaching

Our analyses of this case illustrates how:

- the teacher's questions are carefully sequenced and how students are expected to articulate their thinking through providing explanations;
- the teacher uses sophisticated instructional strategies in explaining proof problem solving for lower secondary school students;

Pedagogic theory

Heuristic nature of teaching of Prof Zheng:

- teacher focuses on process of proving as well as the result

Theory of variation of Prof Gu:

- teacher varies problems from a "problem to find" to a "problem to prove", and varies questioning from involving students in conjecturing to leading them to deductive reasoning about their conjectures

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Pedagogic theory

Problem solving of Prof Polya:

- teacher encourages students in *hunting for the helpful idea*

Transformational reasoning of Prof Simon:

- in determining mathematical validity in the classroom, the teacher involves students in not only inductive and deductive reasoning, but also a third type of reasoning - *transformational reasoning* (the ability to consider, not a static state, but a dynamic process by which a new state or a continuum of states are generated)

Pedagogy, proof and proving

Each theory is partial; some emphasize the role of the teacher and not the student thinking, while others emphasize the role of the student and not so much the teacher thinking.

In the West, much theory focuses on examining the nature of classroom tasks from a *learner's cognitive perspective* rather than from *a didactical perspective.*

In the East, the *heuristic nature of teaching* and the *theory of variation* are very useful as they focus on the dynamic role of the teacher.

Pedagogy, proof and proving

Yet much remains unexplained in this case study:

- Why did the teacher consider investigating the problem in a dynamic way?
- Why, in particular, did the teacher ask those specific questions such as what remained invariant and what varied during the motion?

Pedagogy, proof and proving

- Why should angle AOF receive particular attention by the teacher?
- Was it the aim of the lessons that those specific pieces of knowledge come naturally together? Alternatively, which came first during the problem solving, inductive facts or deductive knowledge?

Concluding comments

In our research we focus on how improvements in student capabilities with proof and proving might result from the identification of good models of pedagogy, *explained by suitable pedagogic theory*.

We identify that *the main need is for deeper thinking on the relationship between teachers' instructional practices and the development of students' reasoning*.

This is where collaboration between East and West might be most useful.

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Thank you for your kind attention