Teachers’ collective work inside and outside school as an essential spring of mathematics teachers’ documentation: Japanese and Chinese experiences

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Journals for math teachers

Dictionary for teachers

Teachers’ resources

Book by famous teacher

Teacher club (online resource)
Teachers’ collective work

Collaboration research team

Conference for teachers

PReMATT project in Lyon

Lesson Study in Lyon
How we see this complex works

• Documentational approach to didactics
  – Document = Resources + Scheme of utilisation
    (Guedet & Trouche, 2012, p. 25)

• Scheme
  – “the invariant organization of activity for a certain class of situations” (Vergnaud, 2012, p. 88)
  – 4 components
    • Goals, sub-goals, and anticipations;
    • Rules to generate the activity;
    • Operational invariants;
    • Possibilities of inference.
Preparing a lesson for an ordinary class

How to teach this? I create a worksheet, then for the rest, I will see in the classroom.

Preparing a lesson for an open class

What activity? I have to create a good one! I also need to write a lesson plan...
In this presentation

• Main questions
  In a given setting of teachers’ collective work,
  – What kinds of teacher‘s work are carried out and in what way? (class of situations)
  – What kinds of resources are used and/or developed and in what way? (resources + scheme)

• Through two east Asian examples
  – China: teachers’ collective work inside school
  – Japan: teachers’ collective work outside school
• What kinds of teacher’s work?
• In what kinds of setting?
• With what kinds of resources?
Structured system-from the top down

• Teaching research group (TRG) is the important setting of teachers’ collective work inside school in China.
• All the schools in China have teaching research groups, and teachers observing and discussing each other’s lessons are commonly guaranteed by the teaching research system.
• There is more than 60 years’ history since the school-based teaching research system was set up in China.
Government’s policy

- In *Secondary School Teaching Research Group Rulebook (draft)* issued by MOE in 1957, the study function was emphasized: “A Teaching Research Group is an organization to research teaching. It is not an administrative department. Its task is to organize teachers to do teaching research in order to improve the quality of education, and not to deal with administrative affairs”.
In order to make policy practicable, one “three – level – institution “ network (三级教研制度) was constructed.

- **Province level Teaching research offices (TRO)**
- **Town/City level TRO**
- **School level Teaching research group (TRG)**

The both TROs play the role of administration and professional guidance. In order to implement the national curriculum reform or other educational reform, they will design some kinds of programs which schools need to follow. But on the other hand, they provide also professional guidance based on schools’ particular needs.
School internal mechanism (学校内部机制)

There exist different kinds of groups where teachers work collectively inside school

- Grade and subject related lesson plan preparation group (备课组)
- Subject related teaching research group (学科教研组)
- Research project group (课题组)
School internal mechanism (学校内部机制)

There exist different kinds of group where teachers work collectively inside school

• Grade and subject related lesson plan preparation group (备课组)

Teachers from the same grade and same subject gather together, lead by an experienced teacher (group leader 备课组长).

They:
• discuss how to arrange each unit of mathematics content within one semester
• and discuss also how to prepare each lesson plan together, how to use other additional teaching materials obtained through individual ways.
• discuss how to develop examination
• often observe their lessons each other and discuss how to improve teachings.
Resources circle (closed?)

Teaching materials provided by schools
(Textbooks, teaching guidance books,
curriculum standards, organized in-
service training...)

Focused on developing
mathematics lesson
and examination at
certain grade

Teachers’ experiences
(individual)
(teaching practices experiences,
self learned resources...)

Online resource,
journals for teaching
......
• **Subject related teaching research group (TRG学科教研组)**

Teachers from the same subject gather together, lead by a subject head. There are three focuses in general.

- TRG focus on discussing teaching practices: instructional design, mid-semester examination, internal open class...
- TRG focus on school based research questions related teaching practices. (Many schools set up school based research project funding, so TRG will also propose their own research project focused on teaching practice problems and apply such school funding
  - “How to improve geometrical understanding with support of dynamic software”
  - “How to design mathematics lesson based on students’ mathematical mistakes from their homework”
  - ......)
TRG is in charge of connecting City level TRO. TRO provides teachers with opportunities to participate in teaching evaluation program or teaching competition, or participate in other tasks which are assigned by City-level TRO.

A director of city level TRO went to school, and informed mathematics TRG in school that there would be city wide teaching skills competition and TRG should select teachers according to some rules, to take part in the competition.
She won the city level competition

TRG organized the school based teaching competition

Teachers who won the school competition, discussed and modified lesson plans in TRG

Teachers demonstrated lessons based on modified plans

The teacher participated in the city level competition

Advisories from TRO

TRG decided who could attend the city level competition
Diversity of Resources

Teaching materials provided by schools
(school based research funding, textbooks, teaching guidance books, standards documents, organized in-service training...)

Teachers’ experiences (individual)
(teaching practices experiences, self learned resources...)

Resources from city level TRO (city level teaching competition, teaching evaluation, city wide examination...)
Resources from researchers outside school (educational theories provided by researchers, shared teachers’ research experiences...)
• Research project group (RPG 课题组) lead by a director of research in school
• To apply for research projects at the city level, or province level, or national level, and to carry out it.
• To undertake one particular project assigned by outside school group.
• For example, the research group from Shanghai Academy of Educational Sciences presided the project “Construction of an innovative model to promote teacher professional development” (began in 2003)
• Some schools got assignment from the project, so the research project group would be set up, in order to implement such su-project which focused on improving teaching qualities through instructional design and reflection.
Together with the project leader, Prof. Linyuan Gu, some school-based research project groups developed and modified their own instructional designs according to this mode.
• A school has the position of “director of research” in general, but Research project group works only when the school will carry out research project at city or higher level, or the school will take part in higher level research projects.

• Who will be the member of Research project group, depends on what research topic is, so the constitution of research project group is dynamic, but the “director of research” is fixed.
Resources for RPG

- School developmental plan; School level previous research experiences
- Teaching practices; other teachers’ experiences
- Theoretical framework, researchers’ experiences, literatures (articles, books), research methods
- Research project group
Inside school

• There exist the three “regular” teaching research groups where teachers work collectively. They have different targets:
  – **Lesson plan preparation group** focuses on preparation of concrete lessons related to particular content in order to improve their own teaching quality, students’ achievement, help novice teachers to be familiar with textbooks and teaching methods..
  – **Teaching Research Group** pays attention to manipulation of curriculum resources, on organization of open lessons, or proposing research questions based on practices.
  – **Research project group** works when schools will apply a research program at province level or others.
• Such structured mechanism can ensure teachers experience collective working culture at schools. But in this culture teachers express more “collective voice” than their individual voice.

• Such “collective work” couldn’t reflect individual requirement of teachers’ professional development fully.
Facing challenges of curriculum reform, the school-based teaching research is experiencing changes. The changes result not only from the change in the way of teaching and the way of research, but also the change in the way of learning and the way of experiencing for teachers.
Fortunately, school based teaching research activities is not isolated, in other words, many schools open the door and welcome or invite experts from outside.

The boundaries of Teaching Research Group and Research project group become vague.

Experts from city level TRO, researchers from university, and school teachers constitute one collaborative team which will focus on teaching practice problems initiated by school teachers.

Here is one mode - Collaboration Research Group Model, which nature is “study for improving teaching and learning, thinking for development”. For 10 years this model has been established and implemented at schools.
One case: Collaboration Research Group Model

- Research project group (课题组)
- Teaching research group (学科教研组)
- School teachers
- Experts from city level TRO
- Researchers from university

Sharing teaching recourse, sharing teaching reflection, sharing research methods
Collaboration Research Group Model

• During the investigation in school, teachers explain their needs that they will be capable of analyzing their teaching behavior based on particular framework in order to improve their lessons targeted

• This model focused on two kinds of school based research activities:
  – How to analyze lessons using video analysis
  – How to reflect lessons using method “same topic, different focus and structure (同课异构)”
The framework of studying classroom behavior based on video analysis

First
- Lesson observation
- Record the class
- Communication
- Collect documents

Second
- Lesson Record
- Record the behavior of teachers and students and the time
- Choose frequent behaviors

Third
- Choose different lessons from expertise and new teachers
- Teaching behavior analysis
- Concept lesson, exercise lesson, proposition lesson, revision lesson

Fourth
- Coding
- Organize
- Classification
- Analysis

Quantitative Study

Fifth
- Teacher questionnaire and interview
- Verify coding effectiveness

Sixth
- Summarize the basic characteristics of classroom teaching behavior of excellent teachers in four kinds of lesson
“same topic, different focus and structure (同课异构)”

• Focused on some topic, different teachers would prepare lessons in different ways
• After implementing the different lessons, teachers shared their ideas of instructional design with certain peoples (other teachers, or researchers, experts)
• Certain peoples comment the lessons
• Teachers reflect their lessons and consider to what extent their teaching targets designed was realized
Example

• Same topics: reviewing geometric knowledge at Grade 9

• Two teachers designed two example lessons:
  – *An Investigation of a Rotational Question* - *General Repertory of Geometric Inquiry* made by Principle Shao Wenhong
  – *Geometry Exploration Journey* made by Yu Li.
**Teacher Shao: An Investigation of a Rotational Question - General Repertory of Geometric Inquiry**

- **Task 1:** As pictured, in \( \triangle ABC \), \( \angle C = 90^\circ \), \( \angle A = 30^\circ \), if we let \( \triangle ABC \) rotate 30° counterclockwise around point C to get \( \triangle A'B'C \), what can you find from the image (please draw the image first)?

- **Task 2:** If we change the angle of rotation into \( \alpha (0^\circ < \alpha < 45^\circ) \), do the conclusion from task 1 change?

- **Task 3:** When \( \triangle ABC \) is a general triangle, what have you found?
• The teacher gave Conclusion of the lesson: General Repertory of Geometric Inquiry
  1. determine the research objects
     (geometry elements—determine problems)
  2. exploring the research contents
     (Explore the invariant relationship in change, the relationship between geometric elements)
  3. Inductive research methods
     (the method which can solve special or general tasks)
Teacher Yu: Geometry Exploration Journey

(1) In Figure 1, in the isosceles right triangle ABC, point E is a moving point on AB;

(2) In Fig. 1, in \( \triangle ABC \), \( \angle ACB = 90^\circ \), AC=BC, points E and F are two moving points on AB, and \( \angle ECF = \angle A \).

(3) If \( \angle ACB = 90^\circ \) is changed to \( \angle ACB = \alpha \) (\( 0^\circ < \alpha < 90^\circ \)), Other conditions remain unchanged. Do the above conclusions still exist?
This Collaboration Research Group Model comprise school teachers, researcher and expert from TRO. They share their analysis each other.

Researcher (Prof. Ye): These two lessons fully embody the nature of the 9th grade review of geometry: grasping the object of geometric, using special-to-general thinking to explore the relationship between elements in the figures, so as to find unique and concise conclusions.

Difference related to content:
• For the first case, the triangle ABC itself rotates. The two triangles (triangle ABC and triangle A’B’C’) exist here are two same triangles. The tasks evolve as follows:
  from determined angle rotation to any angle rotation;
  from isosceles right triangle to general triangle.
• For the second case, we choose the moving point on one side of triangle ABC. The two triangles (triangle ABC and triangle EFC) exist here are probably not the same. The tasks evolve as follows:
  from one moving point to two moving points;
  from isosceles right triangle to right triangle.
• Difference related to instructional design:
• The first teacher uses this task to let students experience the process of how to explore the relations with moving points. The purpose of this task is to teach students the steps of exploring geometry relations: determine the objects (geometry elements), explore the contents, generate the methods. So the task is used by teacher guiding.
• For the second teacher, this task is more open for students. No conclusions were preset by the teacher before the class. So during the teaching process, teacher decides or changes his way to teach based on the different responses given by the students. Which means teacher would use different teaching methods when working with different students. Students are more initiative to decide what to explore when working with the task.
Sun Diru, a mathematics researcher from the Zhejiang Provincial Teaching and Research Office gave a high evaluation of these two lessons from the necessity, objective, structure, and effectiveness of a class. He encouraged us to maintain such an atmosphere of teaching and research, trying and innovating, and to provide teachers meta motivation for quality education, teaching and research. Xu made a comment on these two classes, profoundly analyzed the hidden educational value behind the two classes, fully affirmed the value and significance of the two classes for junior high school students, and at the same time used the “learning case” and “teacher questions”, to give guidance.
• The leader of mathematics teaching research group Lv Hongbin represented other participating mathematics teachers. He said that he has learned a lot from the activities. After reviewing the original features of the lesson and geometry class, he must apply the ideas and methods learned from the activities to ordinary teaching practice, live up to the guidance and expectation of experts and predecessor.
Conclusion

• Chinese case: inside school
• different kinds of structured organizations (groups for collective work)
• vivid resources were brought into inside school and collective work was enhanced
• What kinds of teacher’s work?
• In what kinds of setting?
• With what kinds of resources?

OUTSIDE SCHOOL: A JAPANESE CASE
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<tr>
<td>Nation</td>
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(see Miyakawa & Winsløw, 2017)
City : local association

• In Joetsu area
  – Organisation: Research Association for Teaching Mathematics in Joetsu
  – About 90 registered members (primary and middle school teachers)

• Activities
  – Monthly seminars: Sigma-kai meeting
  – Lecture by invited researcher
  – Workshop for teachers
  – Publication of bulletin, book, etc.
  – Annual congress (one day) including open lessons and oral presentations of teaching practices.
Annual congress of local association
Monthly meeting

• Organisation
  – Monthly meeting (9 to 10 times a year)
  – Last Wednesday evening from 18:30 to 20:00

• Activities
  – Discussion on the lesson plan
  – Discussion on the teaching practice report

• Participants
  – Voluntary basis: no obligation, no reward.
  – primary school teachers, middle school teachers, educational advisors, school principals (ex-math teacher), university professor, students, etc.
Case 1: discussion on lesson plan

• Activity
  – Discussion on the lesson plans for the open lesson of the next annual congress which will be held at the attached elementary school.

• Handout
  – Lesson plan (A3 format with two pages of A4)
Lesson plan

Title: View from inside of the box

For a sequence of lessons

1. Goal of activities
2. Intentions of activities
3. Actual state of children
4. Characteristics of these activities
Lesson plan

Structure of plan

5. About this lesson
   (1) Goal of this lesson
   (2) Characteristics of this lesson
   (3) Development of this lesson (table)

For a specific lesson
To share teacher’s ideas behind the lessons and the setting of the lessons.

Roles of lesson plan

A guide for the readers how the lesson goes on, not a guide of what to do and say in the classroom for this teacher.
Behind the lesson plan

- 3 kinds of teacher’s works (or situations)
  - Task design (≈ kyozaï-kenkyû)
  - Lesson design
  - Writing of a lesson plan
    (situation of formulation)
Case 2: discussion on practice report

• Activity
  – Discussion on the teaching practice reports which will be presented at the regional congress of teacher association.

• Handout
  – Teaching practice report of 6 pages
## Institutional frameworks

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(see Miyakawa & Winsløw, 2017)
Case 2: discussion on practice report

• Activity
  – Discussion on the teaching practice reports which will be presented at the regional congress of teacher association.

• Handout
  – Teaching practice report of 6 pages
児童が自然に道を選ぶための活動の工夫

1. 自主的に活動を進める

毎日、教室の隅で、各グループに30秒間の活動を提供し、児童が自主的に活動を進めることが求められている。

2. 活動の選び方

児童が自主的に活動を進めるためには、活動の選び方の工夫が必要である。

3. 活動の組み合わせ

各グループの活動が組み合わさり、児童が自主的に活動を進めることが求められている。

4. 活動の振り返り

児童が自主的に活動を進めるためには、活動の振り返りの工夫が必要である。

児童が自主的に活動を進めるためには、活動の組み合わせ、振り返りの工夫が不可欠である。
Title

1. Reasons for the choice of this theme
2. Research hypothesis
3. Content
   (1) Verbalization of the problem solving method
   (2) Discussion on the solving method
4. Overview of teaching practices: “Enlarged and reduced figures”
   (1) Let’s look for items of the same shape (Session 1)
   (2) Let’s draw an enlarged figure on the grid sheet (Session 3)
   (3) Let’s draw an enlarged figure using a specific center point (Session 7)
   (4) Let’s draw an enlarged figure using any center point (Session 8)
5. Results and further issues
   • References
Title: Mathematical activities in which children are motivated to participate: through the teaching practices of grade 6 lesson “Enlarged and reduced figures”
児童が意欲的に追求する算数的活動の工夫
～第6学年「拡大図と縮図」の実践を通じて～

上越市立和田小学校 教諭 田中 良樹

1 主題設定の理由

私は日々の授業の中で課題設定を工夫したり、児童が互いの考えを表現し合う活動を設定したりすることを通じて、児童の学習への意欲を高めることを大切にしてきた。みずで、こうすることで算数的活動が充実しやすいと考えきてきた。

しかし、これまでの実践を振り返ると、1つの課題により算数的活動が活発に行われたとしても、課題が解決され、児童の問題意識がそこで満たれていた。「ほかの場合だったらどうか」「どの場合も言えるか」など、条件や観点を変えて、さらに追究している姿がなかなか見られなかった。

そこで、本研究では第6学年「拡大図と縮図」の学習において、児童が意欲的に課題を追究していく姿を指摘していく。課題解決の方法を言語化し、その解決方法を検討することを通じて、目指す姿を具現化していくと考えていた。

2 研究仮説

第6学年「拡大図と縮図」の学習において、課題解決の方法を言語化し、その解決方法を検討することで、児童は意欲的に課題を追究し、その解決方法を理解してみることができるであろう。

3 研究の内容

（1）課題解決方法の言語化

課題解決にあたり、児童が「どのようにして解決したのか」「なぜそう考えたのか」を、児童の言葉で表現させ、段階で共有していく。その際、絵、図表、角度、図形などの概念を構成する要素の言葉を的確におさえていくことによって、図形への理解を深めていく。

（2）解決方法の検討

児童によって言語化された解決方法について、全員で検討していく。第6学年「拡大図と縮図」の学習は、小学校算数の図形単元の最後の単元である。解決方法が「今まで学習してきた他の図形でもあてはまるか」などどのように、条件を変えて適用できるかを考えている。こうすることで、他の図形の場合を調べるなど、新たな課題を追究していく。その中で新たなことに気付いたり、新たな解決方法を言語化したり、それらを共有することで図形の理解を深めていく。

以下に、本研究における授業の大まかな流れを示す。
Practice research

- Research hypothesis
  - “the verbalisation of the method of solving a problem and the discussion of that method motivate pupils to work on the task, and to deepen understanding on the geometric figures”
4. Overview of teaching practices

Task 1: Which one is the same form?

To the teacher’s question why (2) and (4) are not same form, a pupil answered first “he got fat” or “skinny”. But after the teacher’s response “I cannot see well”, the pupil rephrases...
Behind the practice report

- 3 kinds of teacher’s works (or situations)
  - Teaching in the classroom
  - Analysing his own teaching practice
  - Writing a practice report

- Summarize and formalize the main events in the lessons
In monthly meeting

• Teacher’s works
  – Explain his designed or implemented lesson with the lesson plan or practice report.
  – Find a way to improve the lesson.

• Participants’ works
  – Understand the proposed or implemented lesson through the material and teacher’s explanation;
  – Provide some ideas, information, comments, and/or advices to improve the lesson;
  – Get some ideas for their own daily teaching.
In monthly meeting

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  – Get some ideas for their own daily teaching.

Collective work rather than collaborative work
Collective work as a spring

• Outside school in Japan
  – Teachers’ collective work in associations is a trigger to carry out teacher’s documentation works.

  - Teaching in the classroom
  - Task design
  - Lesson design
  - Analysing the teaching
  - Writing of a practice report
  - Writing of a lesson plan
  - Discussion at the meeting
  - Discussion at the meeting
CONCLUSION ET PERSPECTIVES
Conclusion

– School based teachers’ work and teacher training initiated by association in both countries.
– Teaching / Practice research by teachers
– Diversity of resources provided in both countries
– Professional development with documentation work in both countries
– Combination of individual work and collective work
Perspectives

• Research Consideration
  – Documentation genesis with diversity of resources
  – Identify different classes of situations
  – Teachers’ collective work and usage of resources of teachers
  – Discourse between researchers and teachers focused on resource systems
Thank you for your attention!