Lesson Studies in School-based Research & Professional Learning

What lesson studies are we doing now?

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Shanghai Academy of Educational Sciences, China.
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- **The Unique History of Lesson Study in Mainland China**
- **How are we doing our Lesson Studies**
- **What Lesson Studies are we doing now**
- **Four ways of teachers learning in Lesson Study**

The Unique History of Lesson Study in Mainland China

1. Setting up of the four levels teaching research network

> *"Subject teaching research groups should be set up in secondary school. Each subject should have an organized teaching research group, the aim of these groups is to research and improve the way their subjects are taught."*
>
> Chinese Ministry of Education, *"Secondary School Provisional Regulation (draft)"*, 1952

Basically, the task of these groups is to discuss and plan the rate of educational progression for the students. Also, these groups allow teachers to discuss and plan the learning content together.

Provincial Teaching Research Section/Educational Institution

County District Teaching Research Section / Teachers College

Subject Specific School Level Teaching Research Group

Subject & Grade Specific Teaching Research Group

- The four levels network has existed since 1950s and it offers unique advantages
- Teaching consultants act as bridge between the teaching theories and the practical teaching. They play a key role in helping teachers with the lesson studies in their schools.

> *"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."*

...y of Education, ...econdary School Teaching Research Group Rulebook", 1957

> *"Setting up a Teaching Research Group for each subject in each school is necessary for improving teachers' development. It creates an atmosphere within the school that facilitates communication, help and caring support for their fellow teachers. A school is not just a place for students to develop, it is also a place where teachers can continue to learn and improve."*

National Conference on Basic Education Curriculum Reform, December 2003

How are we doing our Lesson Studies?

Lesson Study：From Theory-focused to Behavior Improvement

Existing action: **Focusing on individual experience of teaching** → **New design:** **Focusing on design of the lesson based on new perceptions of teaching** → **New action:** **Focusing on behavior adjustment for student actual acquirement**

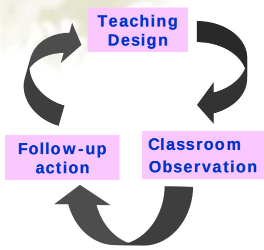
Updating ideas — **Reflection 1: searching for the gap between myself and others**

Improving action — **Reflection 2: searching for the gap between the plan of the lesson and its implementation**

Lesson study as the foundation of the collaboration between teachers and researchers: learning theories, design lessons and reflections

- **lesson study based on integration of classroom teaching improvement and theories learning**

Procedure of Lesson Study for Teaching Research Group



1. ● Studying syllabus and related research paper
● Selecting a sample lesson plan to discuss
● Searching for strategy to improve

2. An improved lesson is given. After classroom observation, both teachers and experts reflect on the plan and its implementation to once again make improvements.

3. The further revised lesson is given. After the teachers and researchers' final discussion, a report covering the whole process is presented. If this work practice is done several times in one semester, a knowledge base of "Action Education" will gradually develop.

A school case: Strategies of research and professional learning based on lesson study

Diagnosis the ordinary lesson：
Find common problems with reference of teaching objectives

↓

Discuss and analyze a sample lesson to generalize agreed strategies to a particular problem

↓

Adopt the generally agreed strategies to develop their own lesson with their styles

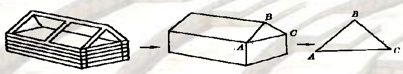
What Lesson Studies are we doing now?

— How are two examples of lesson studies

- **Amphitheater：From application question to problem solving**
- **Capillary Action：Changing from teacher demonstration to students participation**

Amphitheater：From application question to problem solving

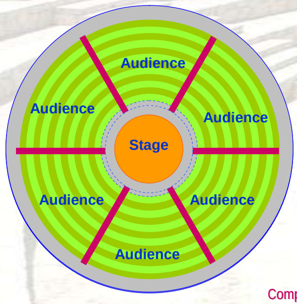
Previous teaching of application questions



Resultant problems:

- A standard application question needs no extra factors or conditions; it has a relatively closed process which uses a standard solution; it is abstract, as the context of the question can be isolated.
- Problem solving is now advocated. It utilizes real-life situations; the conditions, processes and solutions are related to reality and the context can not be isolated.

Design an amphitheater：This problem involves various undetermined factors, so its context cannot be isolated



How to accommodate the largest possible audience, while considering all of the design restrictions: Students must cope with multiple levels of unknown factors by considering the context continuously

- **The audience area should be as large as possible in order to arrange the maximum number of seats; but there are also requirements to the size of the stage, circular path, aisles and seats.**
- **By installing fewer aisles the amphitheater will be able to seat more people; but no single row is permitted to have more than 30 seats.**

Compared to questions which context can be isolated, it is far more challenging to deal with the context to reason and make decisions.

Low level in mathematical problem solving

1.“A tough 20 minutes waiting” —— in the aspect of figuring out the meaning of the problem

One teacher sighed, “…It took a surprisingly long time to break the ice among the students…”
Two teachers asked, “It has been almost 20 minutes, do we need to give them any cur word?”

- **Technical terms**
  Central rotating stage, radiating aisles, circular walkways, seat depth etc.
- **Undetermined factors in the context which cannot be isolated**
  —Students had difficulty identifying that the arrangement of seats in the last row was one of the critical factors of the problem.

2.Oversimplify the problem to be a question of “Area calculation ” —— in the aspect of coping with the restrictions

- Calculating as a question of area
  (Total area － the area of both leg space and sidewalks —area of stage) ÷ area of each seat
- Equating problem solving with the regular application question
  Students are not sure about the amount of sidewalks and they could not take the condition of “no single row is permitted to arrange more than 30 seats” into account

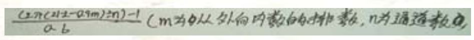
3. Had difficulty in working out the solution as a mathematical formula —— in the aspect of inducting a mathematical formula

In this task, students had to calculate the corresponding lengths of an arc according to different radii, and then divide by 0.6 m（width of each seat）to get the number of seats.

Only 2 of the six groups could come up with a proper formula.

Level 3：*The top level students were able to use letters of the alphabet to create a precise formula*		Group B1	Group A2
Level 2：*Middle level students used numbers and words to come up with a solution.*	Group C2	Group B2	
Level 1：*The lowest level of students were only able to report their results, but were not advanced enough to express their process in achieving their solution.*	Group C1		Group A1

In general, the A, B, and C students’ ability to develop a mathematical formula is not directly related to their test scores. In fact, some group B students perform better than group A students. For example, top level students in group B came up with a more complete formula than mid-level group A students.

Group B1： 

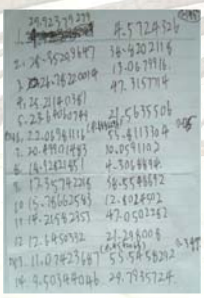
Group A2： 倒数第 n 排座数=[2∏（19—0.9n）—6] ÷6÷0.6

4. Focused on their calculations to solve the question without collaborating or taking others’ ideas into consideration-----in the aspect of Collaboration and Communication

- **Group A students were especially less collaborative than other students.**
  Teacher X：“The students were at once immersed in calculating when they were assigned the problem……I reminded them to discuss it with other group members.”
- **The communication was often limited to the problem of calculation, without involving many attempts to develop a new formula.**

— Students’ discussion was mostly centered on figuring out the result

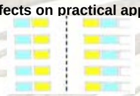
— Students paid close attention to the accuracy of their answer, but seldom questioned the methods or processes of solving the problem.



5. Did not consider whether the solution was actually possible in real life-----in aspect of their working report

In their final solutions, the groups calculated their results with two different methods, which gave two separate effects on practical applications.

The first method:
In accordance with the design restrictions:
“Equal Division Method” (EDM)
the radiating aisles could be kept straight.



The second method：
Neglecting the design restrictions:
“Holistic Analysis Method” (HAM)
the radiating aisles could not be kept straight.

Only group A2 took into consideration the design restrictions and gave the reason why “equal division method” is adopted instead of the “holistic analysis method” (the “holistic analysis method” will result in extra seats.)

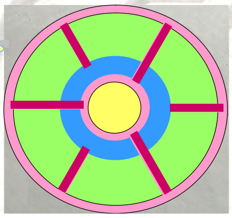
Group	C1	C2	B1	B2	A1	A2
Calculation method	EDM	EDM	HAM	HAM	HAM	EDM
Reported result (seat)	1617	1716(error)	1649	1650	1649	1614

In general, students have trouble with:

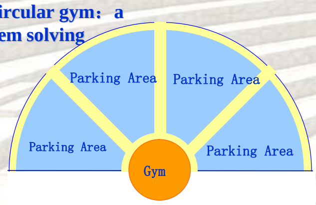
- Drawing pictures and shapes to figure out the meaning of the problem
  - —e.g.: drawing a sketch facilitated to understand the problem
- Logical reasoning and inquiring
  - — e.g.: understanding and working with the restrictions and conditions
- Constructing a mathematical model
  - — e.g.: making use of a table or formula to express the function and its relations
- Collaborating and communicating with others
  - — e.g.: discussing with group members in a mathematical language or working with others to complete the task.

However, there were a few exceptional students who suggested creative plans:

Three of the six aisles are not connected with the central stage. It meets the design requirement increases the number of seats and also takes the overall esthetics into consideration.



Design a parking lot for a circular gym: a comparative study of problem solving ability



More Technical terms

- radiating aisles, semicircular walkways
- aisles between the parking lots, vertical parking, entrance and exit, etc

More undetermined factors

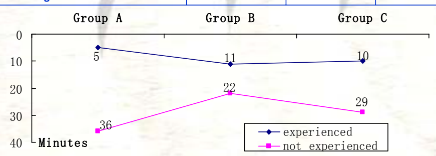
- The parking lot should be as large as possible in order to hold the maximum number of parking spaces; but there are also requirements to the size of the aisles, semicircular path, entrance and exit, parking spaces, etc.
- By installing fewer aisles the parking lot will be able to have more parking spaces; but no single row is permitted to have more than 20 parking spaces
- The way of parking also influences the number of parking spaces. It is an extra complication for the students

① Comparing the time spent on understanding the meaning of the problem

We considered the action of charting and calculating the number of outer spaces or the rows of spaces, as the moment the students understood the meaning of the problem.

Result of comparison:

	A-level students	B-level students	C-level students
Groups that have experienced problem solving.	5 minutes	11 minutes	10 minutes
Groups that haven't experienced problem solving.	36 minutes	22 minutes	29 minutes



② Comparing students' levels of handling the restrictions

Students tried to cope with the restrictions, three of which were critical to decide the number of parking spaces. They were:

(1) The number of radiating channels

(2) The way of parking

(3) The disposition of residual space (far or near to the central stage)

students' levels of coping with the restrictions

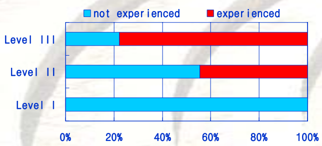
performance / Learning types	Ⅰ. Handled nothing (Could not figure out where to start)	Ⅱ. handled 1 restriction	Ⅲ. handled 2 restrictions	Ⅳ. handled 3 restrictions	Total
Groups that have experienced problem solving	2	1	3	9	15
Groups that haven't experienced problem solving	6	7	2	0	15
Total	8	8	5	9	30

【Notes】 This difference is test via chi-squared test and the result shows that there is significant difference between two types of groups ($p<0.005$)

The table above shows that in the aspect of dealing with the restrictions, students who had been given the mathematics inquiry lesson performed at a much higher level than those who had not. The difference between these two groups is significant.

③ Comparing students' levels of inducing a formula of computing number of parking space

When students went to this step, they had to use a circumference formula repeatedly to calculate the lengths of arc, and then divide by the width of each parking space to get the number of spaces. Can students find the function relations in this process?



Ⅲ. Induced a general formula of computing the parking places

Ⅱ. Created a table list or calculator program of computing

Ⅰ. Had difficulties, can not find the method of calculation

The chart above shows that in the aspect of making use of formula to express the functions, students who had been given problem solving course are mainly performed at a much higher level than those who had not.

④ Comparing students' communication and reflection

When a group of students get together and discuss, it may only be an external performance. The critical things are if students can express their ideas through listening and responding and if they can capture others' viewpoints through constructive criticism.

		Groups that have experienced problem solving	Groups that haven't experienced problem solving
In common		The question most commonly asked was about calculation	
Differences	Find others' advantages	Eg: They adopted the "back-to-back" way of parking, which omit an aisle. It's a good idea.	None
	Give suggestions	Eg: Your group used "equal division method". Why don't you try the holistic way?	None
	Self-reflect	Eg: We can do more observation in our daily life, for example, the way we park cars.	None

Improve students' ability of solving undetermined problems

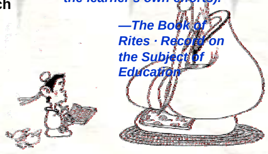
★ The standard application questions strengthen students' basic knowledge and skills. And the basic knowledge and skill are essential foundation of problem solving in real life.

★ Besides the standard application question, it is necessary to create opportunities for students to experience problem solving in which the context cannot be isolated. By problem solving, we can improve students' capability of coping with restrictions in real life.

" 道而弗牵，强而弗抑，开而弗达"
（《礼记·学记》）

"Teacher leads and does not drag; he strengthens and does not discourage; he opens the way but does not conduct to the end (without the learner's own efforts)."

—The Book of Rites · Record on the Subject of Education



Capillary Action: Changing from teacher demonstration to student participation

Previous teaching method： Teacher demonstration

① Teacher designs a experiment

② Teacher demonstrates the experiment

③ Teacher guides the students to conclude the results

New Teaching Method： Student participation

① Observation and classification —— *"Will the water rise?"*

The teacher asked students to stand various materials upright in the basin of water.

Students observed and classified them two types: one can draw water upwards ,and one can not.

The teacher then told students that the phenomenon of water climbing was called "Capillary Action".

Necessary preparation of basic knowledge and experience

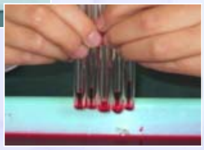
② Looking for common characteristics

—— " With or without holes?"

Teacher asked students to observe with a magnifying glass to discover what the characteristics the items had in common that allowed some of them to draw water upward.

Students observed and reported the common characteristics: small holes or weave. The teacher then responded, "*Does the size of the hole make any difference to how high the water will climb?*" The students then requested pipes and tubes of various sizes to try to answer this question.

Actively asking for more materials



③ Discovering the Rule

—— " The more narrow the tube, the higher the water"

Students stood tubes of various gauges upright in the basin and discovered that the more narrow the tube, the higher the water would climb.

Developing skill of hypothesizing by doing

④ Explaining the phenomenon—— *"Flower & alcohol lamp"*

Teacher asked students to use capillary action to explain the phenomenon of an alcohol lamp and a yellow flower in a vase of red water.

⑤ Unexpected discovery

—— "A beautiful curve "

The teacher asked the students: will water climb up a pane of glass? The students reported it could not because a single pane of glass had no small holes.

The teacher then asked "Is there any way to make the water climb up the pane of glass?"

Students asked for more apparatus. Teacher provided more panes of glass and a few toothpicks.

……

Some students held two panes of glass together while placing them in the water and reported that the water climbed. After hearing the reports, the teacher did not respond immediately, instead, the students were given some time to experiment further and discover some new results.

……

During the time, some students announced that they had achieved a beautiful curve of water when they placed a small ,flat piece of metal between the two panes of glass.

The teacher then led a discussion to explain why this beautiful curve appeared during their experiment.

The limited knowledge constrains a further exploration

To learn **To practice**

"学而时习之，不亦说乎?"

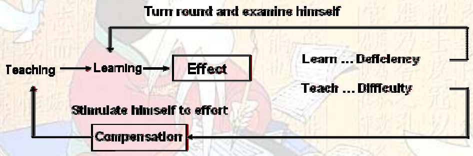
Is it not pleasant to learn from a constant perseverance and practice?

Four ways of Teacher's Learning in LS

- Learning by listening
- Learning by doing.
- Practicing what you've heard.
- Expressing what you've done.

教学相长

Teaching benefits teaches as well as students



“学然后知不足；教然后知困。知不足，然后能自反也；知困，然后能自强也。”

（《礼记·学记》）

when one learns, he knows his own deficiencies; when he teaches, he knows the difficulties of learning.

After he knows his deficiencies, one is able to turn round and examine himself; after he knows the difficulties, he is able to stimulate himself to effort.

—The Book of Rites · Record on the Subject of Education

Thank you!

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