Confucian Heuristics and Mathematics Teaching in Shanghai: Qifa Shi Teaching

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Abstract
This paper reports an analysis of 10 lessons selected from two Shanghai mathematics classrooms in the data set of the Learner's Perspective Study (LPS) (http://extranet.edfac.unimelb.edu.au/DSME/lps/). Five lessons from each classroom (lesson 6 to 10) were analysed using the video analysis software *StudioCode* .The following characteristics of Qifa Shi teaching practice were identified in the classrooms studied. First, these lessons are conducted in a highly structured and unified fashion with the teacher taking the lead in the lesson. Second, neither "teacher-centred" nor "student-centred" is a useful descriptor for these practices. Third, these classroom practices placed a great emphasis on elicitation and guidance. Fourth, the teachers made careful selections of the problems for the lessons. Fifth, the teacher provided timely feedback to students. Finally, the students rarely helped each other or elicited information from each other.
Key words: LPS, Video Study, Mathematics Classroom, Qifa Shi, Coding, Functional Coding

Background of the Study

Mainland China is not a participating country in TIMSS study. But the students in Hong Kong who took part in the TIMSS study were very successful. It is not clear to what extent mathematics in Mainland China is different from or similar to teaching in Hong Kong. However, the success of the Hong Kong students has led to increased interest in the international mathematics education community.

However, many studies as part of Learner's Perspective Study show that there is little evidence to support the existence of a national script[1] (Clarke, Keitel, & Shimizu, 2006).There may not be a single national script for mathematics teaching in China, there may be several common lesson templates that teachers employ for specific purposes. "Qifa Shi" teaching has been the long-standing practice in the field of education in China. The word "Qifa" can be traced back to Confucius and his heuristics. In this context, the most appropriate interpretation of 'heuristics' is assisting to discover. In this paper, we report an analysis of 10 mathematics lessons in two Shanghai classrooms grade-7, linear equations and simultaneous equations , the same textbook from the perspective of Confucian Heuristics, in particular in terms of the Qifa Shi approach to teaching. Five consecutive lessons in the middle of the lesson sequence (Lesson 6 to 10) from each classroom were coded using the video analysis software *StudioCode*. Through coding Qifa Shi teaching practice in each lesson in terms of its forms and functions, we attempt to explore the nature and characteristics of the enactment of Confucian Heuristics in these Chinese mathematics classrooms. Our second purpose is to provide an analytical lens that can be used to investigate mathematics classrooms in China.

Qifa Shi Teaching

The Historical Roots and Developments of Qifa Shi Teaching

The word "Qifa" in contemporary literature refers to establishing associations and understandings through the guidance of others. "Shi" means method in Chinese. Qifa Shi teaching means that the teacher helps the students to establish associations through elicitation and explicit guidance, and therefore to comprehend what is learned. In contemporary Chinese usage, "Qi" is interpreted as the action of the teacher, referring to the process in which the teacher creates a context that could motivate students to learn, to perceive, to imagine, to think and to memorize. "Fa" is the action of the student, referring to the process that student has a desire for learning and cognizing. Qifa Shi is a set of principles that have been influential in teaching and learning in China. Qifa Shi also prescribes particular methods of teaching.

Although the basis of the heuristics method in the East and the West differs, each based on a different set of philosophical and epistemological ideas, they appear to generate a similar pedagogy for guiding instructions. In the West, the first person who advocated a heuristic method of teaching was Socrates. He developed the method of teaching by dialogue or the Socratic method[2]. This approach was further developed by his students Plato and Aristotle to include induction, and the use of heuristic methods to help students acquire knowledge through their own investigation.

Analysis and Results

The Coding Process

Qifa Shi teaching practices in these classrooms were examined and coded in terms of form and function using the video analysis software StudioCode. The development of this coding system involved three stages: at the first stage, we selected several lessons from the classrooms in Shanghai, Hong Kong, Macao, Melbourne, and San Diego. By comparing these teaching practices, we identified the distinctive characteristics of Chinese classrooms and proposed an initial coding system. For the purpose of this study, we selected two Shanghai classrooms that appear to have distinctive features from each other, and we selected five lessons (lesson 6 to 10) from each classroom. Both teachers were recognized as competent teachers by their local community. Our initial observation is that Shanghai Teacher One(SH1) and Shanghai Teacher Two(SH2) seemed to have different teaching styles.

SH1 :

SH2:

SH1 is demonstrating the solution process and asking questions while students are taking notes and answering questions.

SH2 is giving individual guidance and selecting student solutions for public evaluation and discussion.

The common pattern of teaching practice in SH2 was: presenting mathematics problems for the day, teacher analysing and giving hints, student seatwork, teacher giving guidance to individual students, student presenting solutions on board, public evaluation of student solutions, summarizing the lesson, and assigning homework.

The particular features of this coding system reside in the emphasis on the functions of questions and instructions in the classroom and on detailed investigation of the characteristics of Shanghai mathematics classrooms. It documents the ways that each of the two Shanghai mathematics teachers employed the pedagogy of Qifa to facilitate student investigation and teacher-student interaction, which we will discuss in the followings.

The Forms of Qifa Shi Teaching

Three principle forms of Qifa Shi were identified, which are (1) Responding to Questions; (2) Solving Mathematical Tasks; and (3) Teacher Exposition.

Table 1: The Forms of Qifa Shi Teaching Practices

Principle Forms	**Sub-forms**
Responding to Questions	Individual student response
	Whole class response
	Individual responding to a sequence of teacher questions
	Teacher and Students responding together
	Teacher responding to own questions
Solving Mathematical Tasks	Seat-work
	Student-initiated public contribution
	Peer discussion
	Group discussion
Teacher exposition	Guiding whole class
	Giving guidance to individual students

The Functions of Qifa Shi Teaching

The functions of Qifa Shi teaching practice can be classified into four categories: Pudian (Bridging), Comprehend the problem, Guide the solution process, and Evaluation.

1. Pudian (Bridging):Pudian denotes the event occurring before the introducing of the new content of the lesson, which is usually carried out with an attempt for students to solve the central problems, to understand the key concepts, and to apprehend mathematical thinking methods. In the mathematics classrooms studied, Pudian takes on three forms:

(1) Connection. For Example: Teacher: I asked a question, how should we solve a system of linear equations in two unknowns? [Students raising their hands]

(2) Designing transitional/middle problems. For Example: [In order to introduce simultaneous equations, the teacher asked the following question.] Teacher: Okay, there are two equations, according to the characteristics of the equations, what are these two equations called? [Students raising their hands]

(3) Creating the context of a problem.

We have characterised Pudian as bridging because of the connective intent of each of the three forms, but “bridging” is not a literal translation of “Pudian”.

2. Comprehend the problem: Comprehending the problem is the necessary condition for solving the problem. Many strategies are used to help the students to understand the tasks. Five strategies were identified: (1) Student reading problems; (2) Teacher reading problems; (3) Student giving explanations; (4) Teacher giving explanations; (5) Demonstration by teacher.

3. Guide the solution process: The core of Qifa Shi is that the teacher does not tell the student the answer to the problem, but provides cues or pre-contexts to the solution by questioning students or articulating the nature of a problem. Four sub-codes were identified: (1) Analysing the relationships; (2) Pointing out specific methods; (3) Giving hints about the general rules; (4) Reflecting and following up with questions. These are all teacher actions.

4. Evaluation:Four strategies were used for evaluation: (1) Non-verbal evaluative communication; (2) Individual spoken evaluation; (3) Appraisals; and (4) Public evaluation of student solutions.

The Results of Data Analysis

The statistics for the forms of Qifa Shi teaching in SH1 and SH2 are listed in the following figure:

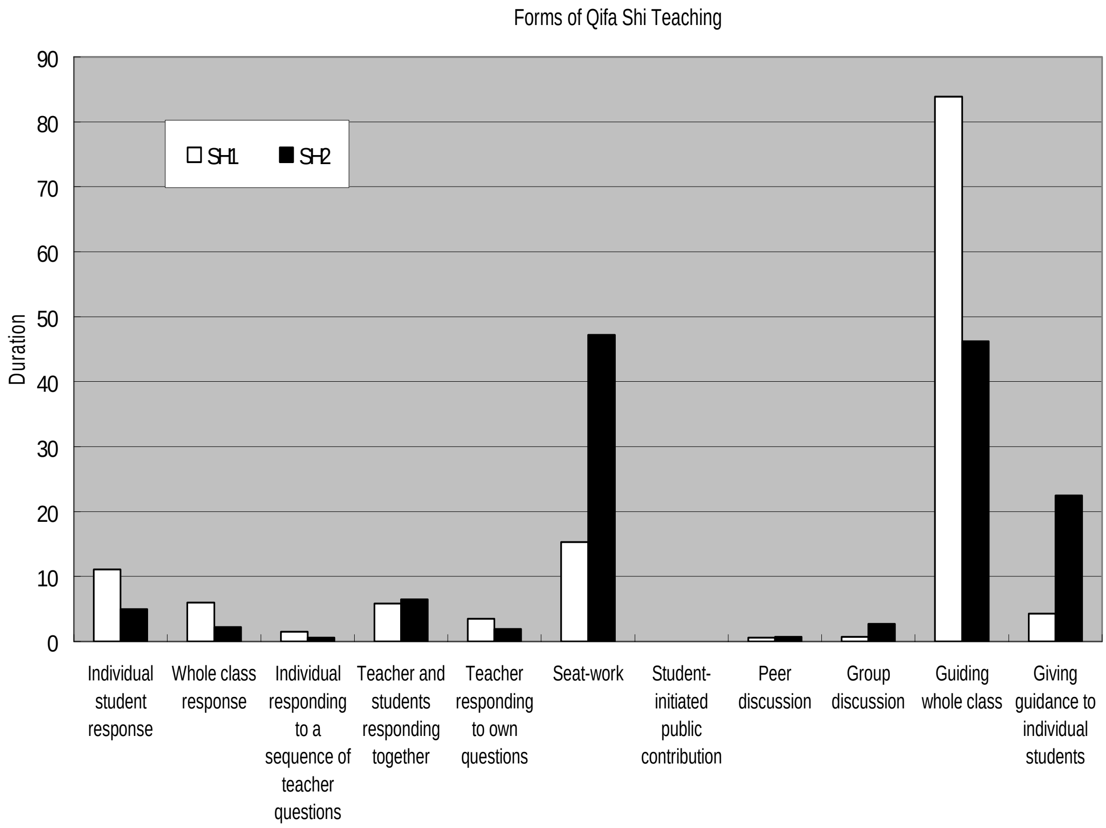
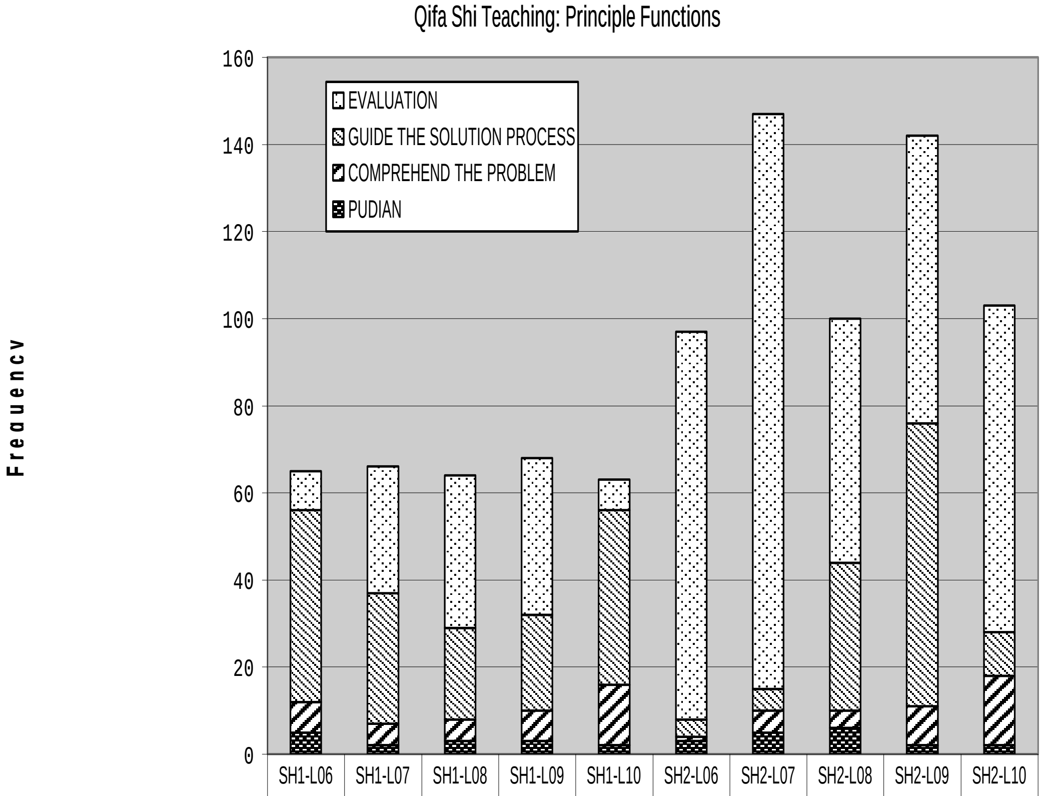


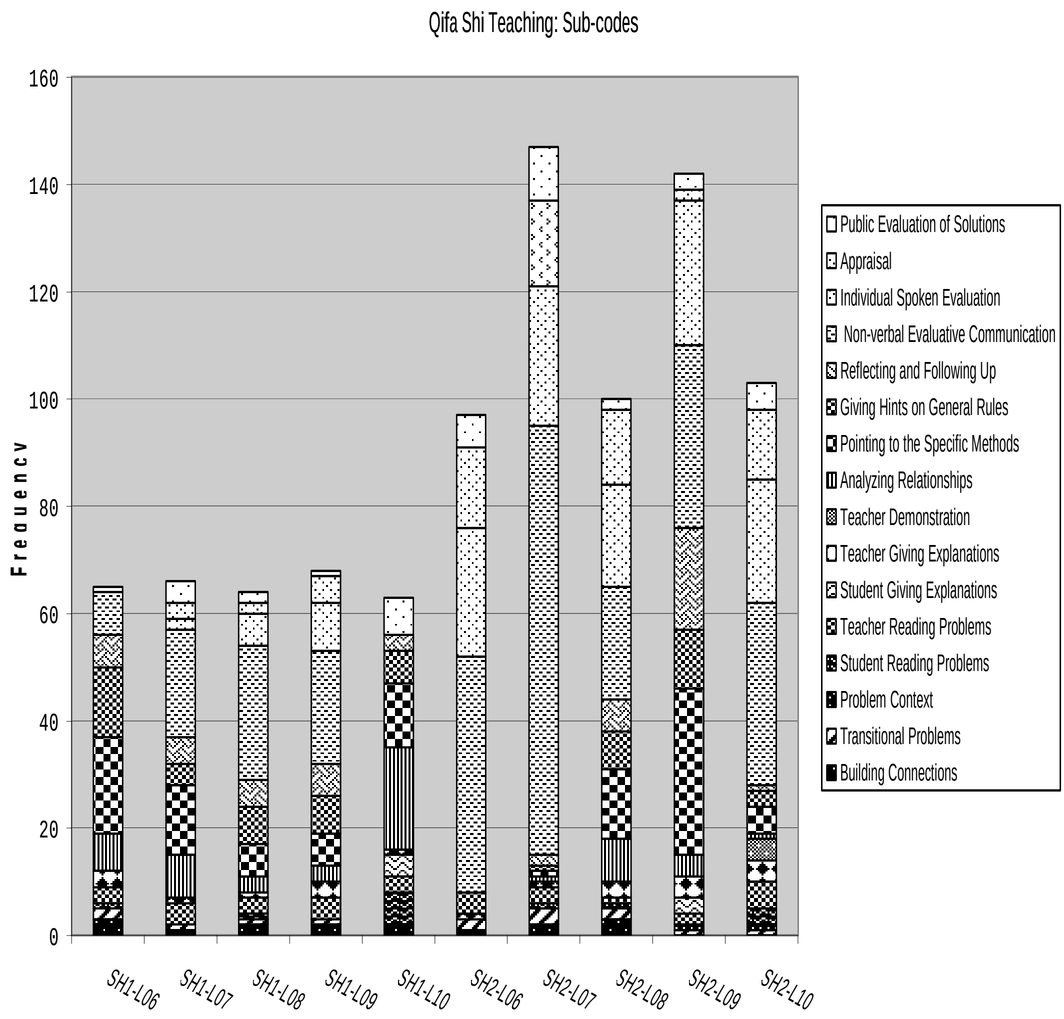
Figure 1 the forms of Qifa Shi Teaching

The statistics for the functions of Qifa Shi approach to teaching inSH1 and SH2 are listed below:



	SH1-L06	SH1-L07	SH1-L08	SH1-L09	SH1-L10	SH2-L06	SH2-L07	SH2-L08	SH2-L09	SH2-L10
EVALUATION	9	29	35	36	7	89	132	56	66	75
GUIDE THE SOLUTION PROCESS	44	30	21	22	40	4	5	34	65	10
COMPREHEND THE PROBLEM	7	5	5	7	14	1	5	4	9	16
PUDIAN	5	2	3	3	2	3	5	6	2	2

Figure 2: the principle functions of Qifa Shi Teaching Practice in SH1 and SH2



Discussion

Based on above figures, we could draw following conclusions:

Firstly, the mathematics lessons are conducted in a highly structured and unified fashion with the teacher leading the lessons.

It can be concluded that the teacher in SH1 spent 86.9% of class time on exposition (including the student answer teacher questions category), among which 83.9% of time were spent on giving instructions and explanations to the whole class, and 15.3% of time on questioning individual students. Almost every lesson studied was conducted under the direction of the teacher. No student raised any questions in class and student discussion time amounted to 1.5%.

SH2, on the other hand, spent less time on demonstration (70%), among which 46.2% was spent on giving instructions to the whole class, but 47.2% on questioning students. 94% of the class time was conducted under the direction of the teacher. There was only one case in which students initiated a contribution to the public discussion, and student discussion time amounted to 3.4%.

It seems that from such an analysis of statistics, it could be concluded by mistake that Chinese mathematics classrooms can be characterised as teacher-centred and as employing transmissive teaching.

Secondly, we would like to argue that Chinese mathematics classrooms can neither be regarded as teacher-centred, nor as student-centred.

Rather, it was found that while the teacher is the one who was leading the lesson, the students were active participants in their classroom, whose interactions were usually mediated by the teacher. In this sense, both the teacher and the students were active participants.

In SH1, 42.4% of class time was spent on responding to questions and student discussion, which were nearly half of the time for teacher exposition (86.9%). In other words, this type of exposition is a form of "bilateral activity" involving the participation of both the teacher and students, but orchestrated by the teacher. Students in this classroom spent 15.3% of class time working independently on problems, which may indicate a level of agency and independence given to the students by the teacher

In SH2, 68.2% of class time was used in student responding to questions, and student discussion, which is almost equivalent to the time for teacher exposition (70%). The teacher made use of exposition to organize discussions. In addition, there was an average percent of 47.2% of class time devoted to student working on mathematical tasks, indicating that the teaching of this teacher involved the participation of both teacher and students, or student solving problems independently with teacher tutoring. This is the dual subjects teaching strategy.

Third, these classroom practices placed great emphasis on the balance between elicitation and explicit guidance, which was accomplished through frequent dialogues between the teacher and the students.

An important characteristics of the Chinese mathematics classrooms is that the teacher exposition to the whole class is conducted using Qifa Shi, which includes the elements: pudian, comprehend the problem, guide the solution process, and evaluation. Therefore, the lessons could be analyzed in terms of the functions of Qifa Shi.

Qifa Shi Teaching practices as enacted in SH1 were:

1. Reviewing old knowledge to help students build associations between old and new knowledge (5.4%);
2. Setting up transitional problems (6.5%) for Pudian;
3. Provide elicitation and inducement to enter the new problems.

SH2, on the other hand, acts in a different way.

1. Reviewing old knowledge to help students to build associations between old and new knowledge (1.1%)
2. Setting up transitional problems (11.2%) for Pudian
3. Setting up problem context (0.3%)
4. Student independent investigation (about 11%)
5. Introduce the new problems

In order to help students comprehend the problem, both teachers employed various methods: student reading problems (1.6% 0.7%), teacher reading problems (6.1% 1.2%), student giving explanations (0.5% 0.3%), teacher giving explanations (1.8% 1.7%), and teacher demonstration (0 0.7%).

In the problem solving process, SH1 and SH2 were not simply lecturing, but engaged in interactions with students through questioning, dialogue and the provision of individual guidance.

In order to facilitate student comprehension of mathematics knowledge and methods, SH1 tended to solve the problems together with the students by initiating dialogues with the whole class. SH2, on the other hand, provided more opportunities for students to engage in independent investigations and gave public evaluations of student solutions.

Fourth, the teachers made careful selections of the problems for the lessons and provided timely feedback to students. The guidance given by the teacher was tailored to specific students needs.

In SH1, the mathematics tasks were solved together by the teacher and the students. The teacher frequently initiated dialogue with the whole class as a way of elicitation and guiding. The average frequency of dialogue Individual student response Whole class response Individual responding to a sequence of teacher questions Teacher and Students responding together)between the teacher and the whole class is around 110 times. By contrast, the average frequency of teacher and whole class talking is 65 times in SH2.

In the first classroom, the teacher devoted more time to solve mathematics problems together, and guide whole class. In Classroom Two, the teacher encouraged student independent investigation and spent more time on giving individual guidance during student seat-work. In general, there were two types of strategies employed by both teachers in giving individual guidance. The first one is to give confirmation and appraisal through non-verbal communication, such as nodding or gestures. The second one is that the teacher would provide appropriate cues for students to reach the answer by themselves instead of giving the right answer directly.

Fifth, the students rarely helped each other or elicited information from each other. Student-initiated contributions to the classroom discussion were absent in the lessons studied.

In both classrooms, Qifa Shi teaching practices were enacted under the teacher's direction. Student discussions, especially student-initiated discussion were very rare in the classrooms studied. In Classroom one, the discussions were amounted to 1.4% of the lesson time in SH1 and 3.4% in the classroom two. There was only one instance in which the student initiated a question to the whole classroom (SH2-L08). It occurred when the teacher made a mistake in the process of explaining the solution process and the student corrected it by saying "subtract equation 3 from equation 1, it is equation 1".

However, in SH2-L10, the teacher asked students whether they have any questions. This instance occurred one and a half minutes before the lesson ended. No students asked any questions, but one student said to himself, "There won't be any questions, it's so easy".

In our view, the characteristics of these two mathematics classrooms outlined above reflect some of the general situations of the mathematics teaching in mainland China.

References.

[1] Clarke, D.J., Keitel, C., & Shimizu, Y. (Eds.) (2006). Mathematics Classrooms in Twelve Countries: The Insider's Perspective. Rotterdam: Sense Publishers.
[2] Plato (1956). Protagoras and Meno, translated by W.C. Guthrie. Penguin Books, Harmondsworth.