

Consideration on the Effect of the Lesson in Problem Solving by Few Children

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Abstract: *This consideration analyzes about two existing lessons of Department of Arithmetic in the elementary school of Japan's detached island of Okinawa. Literacy is examined in this analysis. The purpose of this monograph is to show the effect of problem solving by a small number of people. The analysis framework about the effect of problem solving by a small number of people is used. The framework serves as an affirmative viewpoint and a negative viewpoint. As a result, first it was pointed out that instruction according to one was substantial. Second it was pointed out that the tendency which exact instruction realizes was high. Third it was pointed out that the influence which a leader's ability and the quality of a lesson have was greater than the amount of the children's number.*

1. Introduction

In Japan, instructing few children is widely taken in by the mathematical lessons. The main purpose is for according to individual difference. However, the large majority of this instruction only subdivided the classroom. This does not conclude that the merit of instructing few children is employed efficiently. The first cause is fully not searching for the meaning of instruction to few children. The second cause is that the best method of instructing few children is not clarified. The third cause is that there is very little research on instructing few children. In Japan, in order to realize instructing few children, mathematical teachers are added to school. As mentioned above, it is meaningful about instructing few children to clarify an effect and a limit.

About instructing few children, in order to clarify an effect and a limit, various methods can be considered. The most effective method in these is investigating a lesson in the small school of a class scale. Therefore, I have tackled this research for six years. I got funds from the Japanese government from 2010 to 2012, and performed "Investigation of the Lesson in the Detached Island in Okinawa" (assistance number: 22653110). The first result is that instruction according to individual difference is substantial in the small school of the scale of a detached island. The second result is that the interpretation of the others from whom a viewpoint differs of self is effective, in order to raise mathematical literacy. The third result is that the solution based on various expressions is indispensable. The children of the detached island undertake the handicap in that instruction to instructing the suitable children of the number deepens in study.

As stated so far, it is meaningful to consider instructing few children paying attention to mathematical literacy. It is effective to investigate the actual condition in detail, to develop teaching materials, or to specifically study a method of instruction. However, the educational improvement which paid its attention to mathematical literacy has just started. Furthermore, many teachers do not fully understand mathematical literacy. Therefore, considering instructing few children for the small class of a scale is not studied until now. On the other hand, there is no report of the concrete actual condition in the past research. Now, this investigation is called for.

"Investigation about the Effect and Limit of Mathematical Instruction to Few Children" has been tackled with the fund from Bunkyo University (2013-14). As the part, I set up this subject of research and clarify a part of the result.

2. The Analysis Framework in Few Children's Instruction

Ishii (2013, a) was a bunch of 30 case studies. The result of the research is the following eight points.

- (1) Few children's instruction can embrace individuality.
- (2) Since a child's idea is respected, few children's instruction can obtain many successful experiences.
- (3) Various teaching methods, such as subject selection, are easy for few children's instruction.
- (4) Since few children's instruction reduces a teacher's burden, instruction it is easy to be put into perfect instruction.
- (5) Few children's instruction is difficult to secure the diversity of solution or reasoning.
- (6) Few children's instruction has the strong tendency to respect a child's remark too much.
- (7) In order to secure diversity, a deep argument is difficult for few children's instruction.
- (8) In few children's instruction, since children's human relations are fixed, interactive learning is difficult to learn.

In few children's instruction, since (1) - (4) is affirmative, I define these four points as an "affirmation viewpoint." On the other hand, since (5) - (8) is negative, I define these four points as a "negative viewpoint." I created the following tables to show eight upper points and the lesson scenes 1 and 2, and --. Next, I look for a frame applicable for every lesson scene. Therefore if I corresponded in a frame, I would fill in O. I set up this completed table as the analysis framework about few children's instruction.

Analytic viewpoint		Episode 1	Episode 2	Episode 3	...
affirmative viewpoint	Instruction according to individuality				
	Success experience				
	Various teaching methods				
	Perfect instruction				
negative viewpoint	Lack of various the diversity				
	Excessive respect				
	Argument investigated thoroughly				
	Fixed human relations				

(Table-1) the analysis framework about few children's instruction

In addition, if it can indicate that it is desirable about an "affirmation viewpoint", O is filled in, and x will be filled in if it can indicate that it is not desirable. And about a "negative viewpoint", it is not desirable -- O will be filled in, if it can point out, and x is filled in and it can indicate that it is desirable. Also in these any, since the material for judging is insufficient, when not coming to a conclusion, - is filled in. If there is much O of this analysis framework, it can be judged that few children's instruction is effective. It can be indicated that it was not effective, so that there is much x.

3. Analysis of Lessons of Problem Solving by Few Children's Instruction

(1) The Outline of the Lesson Analyzed

The lesson was carried out at the elementary school where held around 100 children in the detached island of Okinawa in Japan. In this paper, the lesson of the arithmetic of the 3rd grade and the 4th grade which were carried out in the school is taken up. Any grades are a single class and the number of children of each class is about 5-7 persons. The conditions as a lesson by few children's instruction are fulfilled by this point.

Two lessons were carried out on February 24, 2012. Two teachers who taught the lesson are young teachers of the 2nd service school who acted as class teachers. In this area, the teacher of emergency employment occupies 40%. Therefore, these two teachers have the ability above a standard. And the following two lessons are high quality lessons. The lesson in a third grader is not a lesson in a general unit. The focusing of this lesson is carried out to problem solving. The lesson in a fourth grader is a lesson which forms a solid concept.

(2) Analysis of the 3rd Grade "Between Trees"

① The Outline of the Lesson

The lesson taken up here is treating the topic. However, this lesson was not necessarily prepared for this research. This topic is published in the textbook. The lesson advanced certainly by teacher initiative. The teacher was influenced by some children's remark. As a result, the teacher controlled the child carefully. Here, after introducing the scene (Episode 1) of setup in the problem, five episodes (Episode 2-6) are analyzed.

② The setup in the Problem (Episode 1)

Episode 1 is the scene of the beginning of a lesson. A problem is set up while the teacher talks with children. The protocol is as follows.

T: Open your notebook. What do you expect we study?

S: I expect that it is the problem of weight.

T: From now on, I write the problem. "Something is planted along with the side of the road."

S: Is it the problem of length?

T: "The tree is planted every 12 m."

S: I expect that the problem is division.

T: "The brother of Kazumi runs from the tree of one flat knot to eight flat knots." Did someone murmur some?

S: I understand.

T: "How many meters these two persons run"?

S: I understand. The answer was also understood.

It is the introduction of the lesson here and it is the scene where the problem is set up. A teacher does not ignore the children and is not necessarily teaching-like one step. The children said "Is it the problem of length?" or "I expect that the problem is division." Since it can indicate that instruction according to individuality is satisfying from this utterance, O is entered in the column of an analysis framework. In addition, since other three affirmation viewpoints, such as success

experience, do not have sufficient judgment material, - is entered in a column. And since the same may be said of four negative viewpoints, - is entered in a column.

③The Understanding of the Problem (Episode 2)

The purpose of this scene is to reduce misunderstanding about the problem. The teacher promotes an understanding about the problem. The protocol is as follows.

T: What is it in the problem that you understand?

S: Having planted the tree every 12 m along a way is that I know.

T: Can you explain every 12 m along a way?

S: There is a tree and there is a tree at a 12m point from there again.

S: When there is a tree and the tree had followed even a 12m point from there, I had misunderstanding.

S: When there was 12 m between a tree and trees because there was a tree every 12 m, I interpreted.

T: If a tree ends 12 m and is planted, and it opens 12 m and has planted, I will conclude. Did you understand the meaning in every 12 m?

Signs that children have misunderstanding are shown in this episode. Especially I am taking notice of the utterance a child's "When there is a tree and the tree had followed even a 12m point from there and I had misunderstanding." From this order, since instruction according to individuality is fully made, O is entered in a column. Moreover, since that instruction puts into practice can point out, O is entered in a column. In addition, since there is not sufficient judgment material, - is entered in the column of "Success experience" and "Various teaching methods." In addition, since this utterance actualized two or more views about the understanding of the problem scene, it enters O in the column of "Lack of various the diversity." Moreover, since the lesson is not necessarily dragged by this utterance, it enters O in the column of "Excessive respect." Similarly, x is entered in the column of "Argument investigated thoroughly." On the other hand, since the material of judgment is insufficient, - is entered in the column of "Fixed human relations."

④The Correction of the Error (Episode 3)

In the episode 3, the teacher corrects the solution which children mistook. The protocol is as follows.

T: (The teacher looked at the one child's note) Why did you consider 12×8 ?

T: (The teacher looked at other children's note) If solution finishes, think also by another method.

S: Teacher. I think that this is different. We are finding the distance which is running.

T: If the figure was drawn, did you notice?

S: The formula was written after drawing the picture.

T: I permit what Mr. M announces. Compare a friend's idea with your. I advise you to draw the figure.

S: Is it the number of wooden?

The episode 3 is a scene where each child solves the problem by themselves. The teacher observes each child. And the teacher is also the scene of correcting the error that a wooden number and the number between trees are equal. The teacher pulled out "I think that this is different." from the child. Therefore, since it is in the situation which "Instruction according to individuality" and "Perfect instruction" can satisfy, O is entered in those columns. Moreover, since the error is corrected, O is entered in the column of "Excessive respect." On the other hand, since judgment

material is insufficient about "Lack of various the diversity", "Argument investigated thoroughly", and "Fixed human relations", we enter - in those columns.

⑤ Examination by the Analysis Framework of Few Children's Instruction

In addition to the episode 1-3 processed above, I analyzed the episode 4-6 similarly. It is the following tables that summarized the result of eight viewpoints in Episode 1-6 taken up so far.

Analytic viewpoint		1	2	3	4	5	6
affirmative viewpoint	Instruction according to individuality	○	○	○	○	○	—
	Success experience	—	—	—	—	—	—
	Various teaching methods	—	—	—	—	—	×
	Perfect instruction	—	○	○	○	—	○
negative viewpoint	Lack of various the diversity	—	○	—	○	—	×
	Excessive respect	—	○	○	—	—	—
	Argument investigated thoroughly	—	×	—	×	×	—
	Fixed human relations	—	—	—	—	—	—

(Table-2) the analysis framework in the episode 1-6

If the upper table is surveyed, it will be impressive that there is more O than x. This can be concluded that the teacher had well full knowledge of the strong point about instruction of the group of the small number, and a weak point

(3) Analysis of the 4th Grade "The Form of the Box"

① The Outline of the Lesson

The lesson analyzed here is a lesson for 1 hour of the unit "form of a box" written in the textbook. This is not the lesson prepared for this research but the contents clearly positioned in the textbook. The lesson progresses certainly by teacher initiative. Although influenced by some children's gentle remark, the teacher controlled carefully. Here, the scene of the problem setup is first introduced as Episode 7. Next, Episodes 8-12 which are five episode is taken up.

② The Setup in the Problem (Episode 7)

In the episode 8, the teacher shows children the problem. First, the teacher takes out the box of the rectangular parallelepiped. The protocol is as follows.

T: (while it has the paper describing the rectangular parallelepiped) Look at this. What is it that you are looking?

C: It is the rectangle as yes?

T: It is visible to the rectangle?

C: It is visible.

T: Is it right that is visible? There is also a portion of the rectangle.

C: It seems that the rectangle and the square are mixed.

T: Is it visible also to it? In fact, it is the box.

C: Box?

T: We are studying about the box today. (Showing the box) The box is such a form.

C: Did the teacher build it?

T: I get you to make the same box as this using something. (The paper written "Make the form of the box" is shown)

C: Is it "making the form of the box using a stick and a ball of clay"?

T: Yes. The form of a box is made using a stick and a ball of clay. (It writes to a blackboard, "How many sticks are required in order to make the box? How many clayey balls are required?")

In this case, the teacher sets up the problem. A teacher questions a child "What is it that you are looking?", showing a box. Thus, since it can indicate that "Instruction according to individuality" is fully made, O is entered in the column. In addition, since other "affirmation viewpoints", such as "Success experience", does not have sufficient judgment material, - is entered in those columns. On the other hand, since "Various teaching methods" is not made, x is entered in the column. And "-" is entered in the column of other "negative viewpoints."

③The Announcement of Solution (Episode 8)

Children announce various solutions of " How many sticks are required in order to make the box? How many clayey balls are required? " It is also included in the following protocols that the wrong answer is announced.

T: It seems that many classmates from whom an opinion is different are contained.

I permit Ms. B an announcement. Answer the number of a stick and clayey balls.

C: There are 12 sticks and there are eight clay balls.

C: (Several classmates) It is the same.

T: Who is the person of other answers? Yes, Mr. A please.

C: For me, there are ten sticks and there are eight clay balls.

T: Ms. C, please.

C: I think that a stick is the number with 11 and same clay ball.

T: A clay ball is the same. Yes, Mr. D.

C: There are 13 sticks and there are eight clay balls.

T: As for the clay ball, all the classmates have answered it as eight pieces. Signs that children have misunderstanding are shown in this

It is the purpose in this episode to share a solution result. This scene is equivalent to the entrance of learning by children's interaction. Since "Instruction according to individuality", such as speaking the idea from which four persons differ, is fully made, we enter O in the column. Since this is connected with "Success experience" and "Perfect instruction", we enter O in those columns. In addition, since there is not judgment material sufficient about "Various teaching methods", - is entered in the column. Since it is the same, O is entered in the column of "Lack of various the diversity", "Excessive respect", and "Fixed human relations." Since "Argument investigated thoroughly" runs short of judgment material, it enters - in the column.

④Examination by the Analysis Framework of Few Children's Instruction

In addition to the episode 7 and 8 processed above, I analyzed the episode 9-12 similarly. It is the following tables that summarized the result of eight viewpoints in Episode 7-12 taken up so far.

Analytic viewpoint		7	8	9	10	11	12
affirmative viewpoint	Instruction according to individuality	○	○	○	—	○	○
	Success experience	—	○	○	—	—	—
	Various teaching methods	—	—	—	—	—	—
	Perfect instruction	—	○	○	○	○	○
negative viewpoint	Lack of various the diversity	×	○	○	—	×	×
	Excessive respect	—	○	○	—	×	—
	Argument investigated thoroughly	—	—	—	—	—	○
	Fixed human relations	—	○	○	—	—	—

(Table-3) the analysis framework in the episode 7-12

If this table is surveyed, we will notice that there is more O than x. This is the same as that of Episode 1-6. Moreover, it is the same that "Instruction according to individuality" also had much O. This emphasizes that the teacher has well full knowledge of the strong point and weak point of the small number. And it is proved that the teacher was fully observing each child.

On the other hand, that "Perfect instruction" has much O is the special feature which should be observed. And it is interesting that O and x have rivaled "Lack of various the diversity." This is not a characteristic tendency in few children's instruction. Rather, this should be judged that the teacher respected each children's individuality.

4. Analysis and a Conclusions

This paper has discussed instruction of problem solving by the small number. First, the analysis framework about instruction by the small number was set up based on precedence research. And a total of 12 Episode(s) were analyzed about two lessons. The result can be collected to the following two points. The first conclusion is that instruction according to individuality is the greatest advantage in instruction of the small number. Although what we should be careful of is the greatest advantage, it is not being all. The second conclusion is that the following three items determine whether importance sets or not as "Perfect instruction." The first item is in the situation where the lesson set. The following item is the environment where the lesson is carried out.

The last item is the teacher who guides the lesson. On the other hand, if instruction of the small number in mathematics has the following effects like two points in others, indication of it will be possible. In order that the first effect may make a child experience "Success experience", few children's instruction is effective. The second effect enables selection of various teaching methods. We have to pay attention to that the teacher's ability influences it greatly in that case.

However, some subjects also remain. They are expected to be solved as follows. The first is that it is difficult to collateralize various solutions. This is carrying out intentional instruction and a certain amount of relief is possible for it. The second is that there is a possibility of causing the result which esteems children too much. This is adjusting the relation of the children and teacher of those, and can also avoid it intentionally. It is not easy for the 3rd to have a deep discussion. As for this, the design of a teacher's lesson plan plays a very important role.

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