Strategies for Achieving Deep Understanding and Improving Learning Skills: New Approaches to Instruction and Lesson Study in Japanese Schools

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Abstract. Education that facilitates the achievement of deep understanding and the improvement of learning skills to help students prosper in the society of the future has become an important topic worldwide. To achieve this goal in daily instruction, in this study, new approaches to in-class instruction and teacher professional development – ‘thinking-after-instruction’ and ‘three-way review’ – are proposed by a psychological research group in Japan. This chapter describes and exemplifies these approaches and discusses their benefits. It then presents empirical data on their effects in maths education at a school in which they were implemented over a two-year period. The data suggest that the approaches significantly improved the quality of teachers’ instructional strategies and, as a result, also improved students’ use of learning strategies and their maths performance in national tests.

Keywords: deep understanding, learning strategy, thinking-after-instruction, lesson study, three-way review, education in Japan

1 Global Change in Education Goals

One of the most active discussions related to education around the world regards changes in the goals of school education: traditionally, the focus was more on teaching content that was deemed important, whereas educators have now shifted their focus more to helping students obtain competencies that will allow them to prosper in contemporary society. This tendency emerged with the proposal of ‘key competencies’ by the DeSeCo (The Definition and Selection of Key Competencies) project. This project was conducted by the Organisation for Economic Co-operation and Development (OECD), from 1997 to 2003, and the final reports were published in 2003 (Rychen and Salganik, 2003). This project became the basis for the Programme for International Student Assessment (PISA), an international assessment in maths, science, and reading literacy, which targets 15-year-old students. The idea of ‘21st-century skills’ (Griffin, McGaw, and Care, 2012) is also in the same line, in that it encourages skill development as a means to prosper in society. Even at the policymaker’s level, valuing the development of students’ competencies for life in contemporary society has recently been emphasized (e.g. SDGs (Sustainable Development Goals) 4.7 by UNESCO, 2015).
As elsewhere, Japanese educational policies and discussions around curriculum reform have come to place more emphasis on the development of students’ competencies (called 資質・能力 in Japanese). Although the idea of developing students’ ability to prosper in society is not new in Japan and previous discussion on curriculum reform at the Central Council for Education has also focused on this issue (called, at the time, ‘zest for living’ (生きる力) (e.g. Minister of Education, Culture, Sports, Science and Technology of Japan (henceforth MEXT), 1996), this previous discussion did not consider concrete strategies to attain this end. On the other hand, recent discussion regarding the next curriculum reform has included perspectives on how to achieve the goal of fostering students’ competencies. For example, ‘active learning’ is considered important, and in this respect, deep learning (深い学び), collaborative learning (協同的学び), and subjective learning (主体的学び) are valued as general principles for instruction (MEXT, Japan, 2016). However, it remains unclear how these principles can be realised in classroom instruction, and quite a few Japanese teachers are confused about how to adjust their instruction methods in this regard.

In addition, the practical research conducted by our research group, which we termed ‘cognitive counselling’, suggests that a number of problems need to be addressed in regard to students’ learning by in-class instruction. The ‘cognitive counselling’ conducted by our group (Ichikawa, 1989, 1993, 1998, 2005) comprised a psychologist engaging directly in personal tutoring using psychological perspectives. The clients in cognitive counselling are students who struggle with aspects of learning such as ‘I cannot remember well’, ‘I cannot perform well academically even if I take a very long time to learn’, or ‘I cannot get motivation to learn’. The goal of this personal tutoring is not to teach those things that students cannot solve or understand but rather to make them autonomous learners by enabling them to spontaneously use learning strategies that psychological research has revealed to be effective. While the materials used in this counselling vary, this practical research reveals common problems underlying students’ learning difficulties: The first is a lack of conceptual understanding and reliance on rote memorization, the second is inappropriate learning beliefs that underlie the underuse of effective learning strategies (e.g. beliefs that value rote memorization alone, or an orientation that neglects the value of the process and relies solely on obtaining the correct answer). In many cases, students’ poor achievement or suffering occurs because inappropriate learning beliefs result in the poor use of learning strategies, and as a result, poor achievement. Furthermore, this often causes a serious decrease in learning motivation. It has also been suggested that students’ problems do not occur due to their own lack of competencies, but rather due to the poor quality of instructional methods at schools.

Based on this recognition, in order to address these problems, our psychological research group proposes two approaches: the ‘thinking-after-instruction’ approach, to be implemented as part of instruction in class, and ‘three-way review’, as part of lesson study. Both are proposed based on educational psychological perspectives. Lesson study is an approach to the professional development of teachers’ instruction skills that is widely conducted in Japanese schools. In lesson study, a teacher designs an actual classroom lesson by collaborating with other teachers and uses his/her class to demonstrate how his/her idea works in an actual class with students. After the class, all teachers participating in this demonstration engage in a discussion. This process has been considered to contribute to enhancing teachers’ professional
skills. This chapter first introduces both approaches in detail and then examines data on students and teachers from a school in which both approaches have been used for two years to discern the effects.

2 The ‘Thinking-after-Instruction’ Approach in Class

2.1 Core Idea and Background of This Approach

Discovery learning, which aims at minimizing instruction and encouraging students to discover targeted knowledge for themselves, and direct instruction, which aims to provide instruction about targeted knowledge from teachers, are two common and so-called controversial approaches to instruction that have been in place for a long time (e.g. Lee and Anderson, 2013). The conflict between these two approaches has been called the ‘assistance dilemma’ by Koedinger and Aleven (2007), which relates to the fact that teachers must decide whether they provide instruction or refrain from providing instruction. Although the two approaches are basically considered incompatible, the ‘thinking-after-instruction’ approach combines these two approaches (e.g. Ichikawa, 2004, 2008, 2015; Ichikawa, Uesaka, and Manalo, in press; Ichikawa and Uesaka, 2016). Furthermore, two new phases – for checking comprehension and self-evaluation respectively – have been integrated in addition to the simple integration of direct instruction and discovery learning. Although the detailed design principle of the thinking-after-instruction approach will be described in more detail in a later section, the outline of this approach is as follows. A class using the thinking-after-instruction approach consists of four phases: teacher’s explanation (direct instruction), checking comprehension, deepening understanding (discovery learning), and self-evaluation. The more essential point of this approach is achieving deep understanding and improving students’ learning strategy use, as will be explained in more detail in the next section. This is because the practical research of cognitive counselling (e.g. Ichikawa, 1993, 1998; Uesaka, 2010), as described above, showed that students lacked conceptual understanding, had poorly constructed knowledge, and rarely used effective learning strategies. These problems were also considered to have occurred because of lack of instruction methods in school classes. Based on this recognition, this approach was proposed to address problems in education in Japan specifically. Thus, this section first provides a more detailed background to the approach relating to methods of instruction in Japan and then gives a concrete example from the classroom. One of the important background factors in the thinking-after-instruction approach is related to the excessive emphasis on discovery learning in elementary school education in Japan, where discovery learning is usually more valued than direct instruction. Let us show an example of the typical discovery style class in Japan. When instructing in mathematical formulas, such as calculating the area of a triangle or parallelogram in a typical Japanese class, the teacher might encourage students to identify a mathematical formula for the area of a triangle or parallelogram. In this type of class, the formulas found by students are introduced and shared with classmates at the end of the class. This active discussion to uncover and justify target knowledge in collaboration between teachers and students is called nertaji (練り上
and is traditionally considered one of the most important processes in Japanese
education. It is considered more effective than direct instruction as students them-
selves discover why the target knowledge is found. After the targeted knowledge has
been shared with the class, drill practice using that knowledge usually follows.

Despite its advantages and its dominance in elementary school education in
Japan, discovery learning also has several defects. For example, although targeted
knowledge is shared among all class members, the reality is very often that only the
top students give substantive explanations for this knowledge and it is often unclear
how well other students understand. In fact, many students who visit our cognitive
counselling practice report that they cannot understand the discussion between teach-
ers and top students. Second, many students have already become familiar with target
knowledge as a result of attending after-hours education institutions like cram schools.
Third, even if teachers try to convey a conceptual understanding of target material,
many students focus only on the procedural aspect. One of the reasons for this is that
even if the teacher explains the conceptual aspects, the follow-up activities that many
teachers request students to complete merely comprise drilling. It is rare that opportu-
nities are provided for all students to explain the conceptual aspect and thus to check
their understanding. As a result, as shown in case reports from cognitive counselling,
many students struggle because they rely solely on rote memorization and pattern
learning in various subjects.

Another important background aspect of thinking-after-instruction is that
junior high school and high school teachers in Japan overly rely on direct instruction
and rarely provide students with opportunities for discovery learning. In contrast to
elementary schools, teachers at these school levels in Japan value direct instruction
more than discovery learning. The typical flow of this type class is as follows: first,
the teacher explains the concepts to the students; second, the students are asked to
solve related problems; and finally, students’ understanding is confirmed. Although
students receive conceptual explanations, they are never afforded opportunities to
produce the knowledge by themselves.

Although direct instruction is valuable in that the targeted knowledge is pro-
vided explicitly and students will not struggle to ‘discover’ it, this approach also has
several defects. For example, case studies of cognitive counselling show that many
students struggle to follow direct instruction in class. In addition, students may find
that they can solve basic problems using target concepts, but not applied problems, as
they do not understand the material deeply and conceptually (see the case studies
reported in Ichikawa, 1993). Another problem is that many students may lose interest
in learning content if there is no scope for independent engagement with the material
or for challenging oneself. In a related criticism, this style of instruction may not help
students learn to express their ideas.

In order to address these problems, the ‘thinking-after-instruction’ approach,
to be applied in class, has been proposed (e.g. Ichikawa, 2004, 2008, 2015; Ichikawa,
Uesaka, and Manalo, in press; Ichikawa and Uesaka, 2016). As described above, classes
designed using this approach consists of four phases. To help students understand
the reasoning behind target knowledge more deeply, the teacher first provides explicit
explanation of the concept and relevant or underlying concepts (the conceptual aspect
of knowledge), as in direct instruction. Even if the knowledge is more procedural,
explicit instruction may be given as to why this procedure is used or points that students should pay attention to.

In the next phase, checking comprehension, the teacher provides students with activities that they can do to help themselves and the teacher ‘understand their understanding’. As part of this approach, for example, the teacher asks the students to explain their reasoning and process in pairs as the teacher has done (in many cases, they are asked to explain by imagining that the student with whom they are paired does not know about the topic). When students find they cannot explain well, it may mean that they do not sufficiently understand.

In the third phase, the deepening understanding phase, the teacher provides students with an exploratory task to complete in groups, to deepen their understanding. Such a task may focus on an aspect that students might easily misunderstand; for example, in a class on the mathematical formula for calculating a parallelogram, the task might focus on ensuring that the students understand the concept of ‘height’.

In the final phase, the self-evaluation phase, students are asked to articulate what they do and do not understand. They are encouraged to articulate strategies to determine points about which they are unsure (e.g. ‘I can calculate a parallelogram’s area by transforming it into a shape whose area I already know how to calculate’).

If we compare this new approach to the usual Japanese discovery style class which is common at elementary school level, the latter tries to help students discover knowledge in the textbook, but the new approach tries to help them discover knowledge beyond the textbook (that is, it uses textbooks but transcends them). Also, if we compare this new approach to the usual Japanese direct instruction style class which is common at junior high or high school level, the latter instruction style does not afford the opportunity to check students’ understanding by explaining what they understand or through discovery learning, but the new approach tries to create such opportunities for students. Particularly at high school level, discovery learning in groups is rarely conducted in traditional Japanese education, but has begun to be considered important in recent discussion about ‘active learning’ (MEXT, 2016).

2.2 Learning Strategy Use Enhancement with the Thinking-after-Instruction Approach in Class

A central point in this chapter is that the thinking-after-instruction approach effectively promotes students’ learning skills—especially use of learning strategies such as cognitive and meta-cognitive strategies—and deepens their understanding. For example, the underlined parts in Table 1 show instances in which the teacher intentionally tried to promote students’ use of meta-cognitive learning strategies. To do so, for instance, the teacher encouraged the students to read the textbook before class as preparation. In this stage, a teacher encourages the students to find what they have and have not understood. Moreover, especially by the 5th or 6th grade, teachers may advise students to set their own goals to achieve in class. In one class, a student mentioned, ‘I’ve got an idea how we can calculate the area of a circle using a mathematical formula, but I do not understand why this kind of math formula works, so my goal in this class is to understand the reason why this math formula can work’ (Tamashima TV, 2013). In the teachers’ instruction phase, the teacher encourages students to focus on the points that they do not understand when listening to the teacher. In the following checking comprehension phase, the teacher provides a task that allows both the
teacher and students to check their conceptual understanding. Students are asked to
solve a task or to explain conceptual aspects ‘as the teacher did’, often in pairs or
small groups. When they find that they cannot provide some explanation well, they
become aware of the gaps in their understanding. In the final phase, students once
more express what they do and do not understand. By repeating this cycle, students
are expected to develop their meta-cognitive skills and to use meta-cognitive learning
strategies spontaneously in their own learning without any instruction from the teach-
er.

Table 1. Framework for Using the Thinking-after-Instruction Approach Prior to and
During Class (Parts Relating to Meta-Cognitive Learning Strategies are Underlined
and Cognitive Learning Strategies are Italicized)

<table>
<thead>
<tr>
<th>Teacher's Action</th>
<th>Students’ Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before class:</strong> Preparatory Reading</td>
<td>Encouraging students to read their textbooks to prepare for their upcoming classes.</td>
</tr>
<tr>
<td><strong>In class:</strong> Teacher’s Instruction</td>
<td>Explaining the meaning rather than just focusing on the procedure.</td>
</tr>
<tr>
<td>Checking Comprehension</td>
<td>Asking students to solve problems or explain as the teacher did in the teacher’s instruction phase by focusing on conceptual aspects in pairs or groups.</td>
</tr>
<tr>
<td>Deepening Understanding</td>
<td>Providing task(s) applying what they have learned; designed to deepen their understanding further.</td>
</tr>
<tr>
<td>Self-evaluation</td>
<td>Asking students to reflect what they have understood and what they have not understood.</td>
</tr>
</tbody>
</table>
Additionally, as mentioned above, this approach tries to develop students’ cognitive learning strategies and general orientation toward cognitive learning. The parts in italics in Table 1 are places where the teacher intentionally and explicitly tries to promote cognitive learning strategy use and orientation. As our research group’s background is in cognitive psychology, we consider it important to foster students who value conceptual rather than just procedural understanding, focus on process rather than simply obtaining the correct answer, and prize failure that fosters improvement (rather than simply hating failure as such). To achieve this in the teacher’s instruction phase, teachers focus on reasoning and process rather than simply on target content. Additionally, in the checking comprehension phase, the teacher encourages students to explain as the teacher has done. This suggests to students that the goal of the class is to deepen and refine their understanding until they can explain in their own words, rather than simply solving problems. Then, in the deepening understanding phase, students are asked to utilize the knowledge learnt in different contexts, suggesting to them that applying knowledge across contexts is another important goal. Finally, in the self-evaluation phase, students are expected to refer to conceptual aspects of the material and strategic aspects of their learning process, reinforcing the goal of deep understanding. By conducting this kind of class every day, teachers should help students to value conceptual understanding as a whole and encourage them to start using cognitive and meta-cognitive learning strategies spontaneously in their own learning even without special instruction from teachers (for analysis of how students spontaneously use cognitive and meta-cognitive learning strategies in a thinking-after-instruction context, see Uesaka (2014)).

2.3 Example of Thinking-after-Instruction in Class

In this section, we will introduce three example of real class design based on the thinking-after-instruction approach. When designing a class, it is important to consider what kinds of difficulties students will meet in the class (‘difficulty assessment’; 困難度査定; Ichikawa, 2016). Thus, the difficulties predicted when designing the classes are introduced as well as the goals and overall class design.

The first example involves a 6th-grade class whose goal was to achieve conceptual understanding of the mathematical formula to calculate the area of a circle. One difficult point for students that was identified before class was that some students already knew the mathematical formula in question (radius x radius x 3.14) but did not fully understand why it was effective. Others might have been able to calculate the area of a circle but did not fully understand the meaning of the formula itself (especially the fact that the radius is multiplied twice). To overcome these difficulties and ensure that students had learned the formula effectively, the teacher first gave explicit instruction on the formula and why it worked, using ICT tools and diagrams. In the next phase, the comprehension check, the teacher asked students to explain in pairs how the formula could be represented diagrammatically on a worksheet and also asked them to calculate the area of those circles. In the deepening understanding phase, Figure 1 was provided and students were asked to ‘[p]lease consider in groups what the students who said the areas of these several diagrams are equivalent are thinking, so that I can know about it without using actual calculation!’ By engaging in this task, students were expected to understand the deeper structure of the mathemati-
cal formula: that the radius is multiplied twice. More concretely, if we consider the radius of the left part of Figure 1 to be 1, then the circles in the middle and right parts are respectively $1/2 \times 1/2 = 1/4$ and $1/3 \times 1/3 = 1/9$. However, there are four circles in the former case and nine in the latter, so that they have the same overall area as the one left circle. In the final phase, students articulated points that they had or had not understand.

![Diagrams](image)

Figure 1. Diagrams shown in Deepening Understanding Phase of the First Example

The second example comes from a 3rd-year class whose goal was conceptual understanding of the word ‘diameter’. This class was conducted by the third author when he was dean of the Faculty of Education at the University of Tokyo (our research group has a policy whereby even psychologists must demonstrate instructional methods to help teachers understand how psychological perspectives can be utilized in class design. For this reason, we went into an elementary school and demonstrated this method to show teachers that psychological perspectives are useful in class design). Although many of the students already knew the word ‘diameter’ and the concept’s features (such as that it is the longest line that can be drawn within the circle and must always pass through the centre), a lack of conceptual understanding was projected to be a problem. Thus, activities were set in which students measured the diameter or found the centre of a circle. Before class, students were asked to read the relevant material in the textbook as preparation for the upcoming class. In class, during the teacher’s instruction phase, the teacher instructed the students on the definition and features of the diameter of a circle, and ways to measure it. In the class, students approximated the measurement of diameter by using a straight ruler and two triangle rulers, with which students were familiar (Figure 2). In the comprehension check phase, students were asked to measure the diameters of Japanese coins (10, 100, and 500 yen) in pairs. In the deepening understanding phase, students were asked to find the centre of a circle on a piece of thick paper and use it to make a spinning top in groups (see Figure 3). Several groups discovered that they could find the centre of the circle by relying on the feature whereby the diameter always crosses the centre—thus, multiple diameter lines can be used to locate the centre by triangulation. Finally, students were asked to articulate what they had and had not understood.
Although the examples described above all involved elementary school mathematics topics, the approach is not limited to the mathematics context or to the elementary level. Ichikawa and Uesaka (2016) introduced 20 lesson plans using this approach in various fields including maths, Japanese language, science, social studies, moral education, and English. In addition, lesson plans at the junior high and high school levels have also been presented (e.g. Ichikawa, 2015), and the practice has been used in the context of higher education (Uesaka, 2011). Let us consider one example from a non-maths context, from a 5th-grade Japanese language class conducted by the first author. The material used is a famous Japanese story, ‘God in straw boots’ (わらぐつの中の神様) by Mikiko Sugi. An outline is as follows:

A girl, Masae, hated her straw boots because they did not look cool; but her grandmother encouraged her to use them when the shoes she usually wore in the snow were wet. The grandmother started to tell Masae that God was in the straw boots, and that once upon a time, a young girl named Omitsu wanted to get cute Japanese wooden clogs but could not ask her parents as her family was too poor. So in order to get the clogs, Omitsu started to make straw boots herself for selling. The first boots she made did not look good at all, but she cared a lot about the wearers and wove the straw tightly, not leaving any space. The boots were very ugly, and when she was selling them, a lot of people laughed at them, but one young carpenter bought the straw boots every time she sold them. When she asked him why, he said that ‘the value of the work is not decided by its appearance. How much the maker considers the users is more important. Objects made with sincere considera-
tion for the user include God within them’. After saying that, he proposed to Omitsu that they get married as ‘a person who makes such things is next to God, so would you come to my house? I will treat you as God’. (After these words of the carpenter, we return to the scene of the grandmother and Masae.) Masae learns that Omitsu is her grandmother and the young carpenter is her grandfather. After listening to the story, Masae starts to articulate the comments, which suggests she is changing her sense of values, and that she believes that everything in which one can sense sincerity contains God.

The unit that goes with this story has the following goals: first, understanding the story from three perspectives (structure, scene description, and personalities of the characters) and developing the skills to interpret its message; and second, writing the short advertising messages to accompany other stories written by Mikiko Sugi using the skills for interpreting messages that they have gained in class. The characters’ personalities in particular were expected to help students understand the message, but a difficulty was predicted: students did not have any concrete strategies for understanding the characters’ personalities. Thus, this class focused on ‘sense of values’ as an aspect of personality and instructed students on how to identify sense of values in a literary work. Finally, to help students apply those perspectives when reflecting on their own lives and develop their own values, the class also included activities to help them review their own lives in terms of the sense of values emerging from the story.

The concrete flow of this class was as follows. As this targeted class was the 7th class out of 10 hours in total for this unit, students already knew the story. Thus, as preparation before class, students were asked to write down what the young carpenter considered important and why. In class, the teacher first instructed them that it is sometimes possible to understand the message of a literary work by understanding the sense of values of its important character(s), and taught them to identify the sense of values with the aid of a diagram (Figure 4). In Figure 4, the square parts represent what the character says and does, while the oval parts show the underlying sense of values, captured by considering what ideas unite what the character said and did. The teacher presents a concrete example from the story (from his comments to Omitsu and his behaviour, for instance buying the ugly straw boots, we might think that the young carpenter’s sense of values posit that ‘it is more important for something to be made with sincerity rather than to be of good appearance’). In the checking comprehension phase, Masae’s sense of values before and after listening to her grandmother’s story were analysed in groups by filling in a values diagram worksheet, based on examples shown by the teacher. The answers were shared with the whole class. In the deepening comprehension phase, students were asked to review their lives from Masae’s perspective. The teacher asked the students ‘Are there any objects around you that you feel include God inside when you get the perspective of Masae, or are there any objects around you that you treated badly even though you think they might include God inside from the current perspective of Masae?’ Students engaged in this task in groups and also shared their responses in class. At the end, students articulated what they had understood and not understood.
3 A New Approach to Lesson Study: ‘Three-Way Review’

3.1 Background to the Use of Three-Way Review in Lesson Study

Our research group also proposed a new approach to lesson study, called ‘three-way review’ (三面騒議法) (Ichikawa and Uesaka, 2010; Ichikawa, 2016). Lesson study is a Japanese system used to enhance the quality of instruction among teachers in a school. It is a cultural institution in Japanese elementary schools, and almost every elementary school in the country has several chances per year for all teachers to conduct lesson study. Lesson study is also conducted in junior high and high schools. This system has contributed to keeping the quality of Japanese education high and also to maintaining high standards across schools. Traditionally, the typical process of lesson study is as follows: first, participants watch a class together; second, they share comments with all participants (without prior discussion in small groups; cf. below). External commenters like academic university staff may also add some comments.

Although this system is valuable, traditional lesson study has several problems. For example, participants sometimes find it difficult to speak honestly, as they do not want to damage their relations with the teacher giving the class. Also, participants may find it easier to comment honestly to younger teachers showing their class but more difficult with older teachers; finally, from a cultural perspective, Japanese people tend to hesitate to contribute to discussions, such as asking questions, so some people may have trouble commenting even if they do have something to say. When such problems occur, even if the teachers share their comments, it may be difficult for these to lead to deep discussion or contribute to enhancing the development of the teachers’ instruction skills.

Based on these considerations, three-way review in lesson study was proposed as a way of conducting lesson study more actively. Recently, a new style of lesson study has been proposed in Japan, that is, workshop style lesson study, which includes an active session such as small group discussion rather than simply providing a lecture from a knowledgeable person (Murakami, 2012); three-way review can be positioned within this style of lesson study. The procedure is slightly different from
the traditional style of lesson study. First, participants watch a class together, and each
participant writes comments on sticky notes of three colours (red: good points, blue:
points for improvement, yellow: points that can bring in learning from other units or
subjects). After watching the class, participants first get together and share their ideas
in small groups (3–6 participants per group). Second, each group presents all the
comments it has heard to the other groups. Finally, facilitators may pick up some
points and discuss them with all participants. In some cases, external observers like
university researchers may add comments.

Figure 5. Teachers in ‘three-way review’; Discussing methods of instruction with
small groups (left) and Sharing comments with all members (right).

This approach has several important features. First, the structure of the pro-
cess encourages all participants to talk sufficiently, especially with the inclusion of
the small group phase, which may help Japanese participants in particular to feel com-
fortable sharing their views. Second, devices are incorporated to encourage partici-
pants to provide negative as well as positive comments. First, all comments shared in
small groups are shared with all participants, but without specifying which individual
person has made them; this anonymity addresses the problem of participants worrying
about their relations with the teacher who is showing his or her class. A second im-
portant device is that when participants suggest points for improvement, they are en-
couraged to provide alternatives (e.g. another method of instruction or of conducting a
task) by imagining what they would do if they themselves were the teacher. This too
is expected to contribute to meaningful discussion.

3.2 Combining Thinking-after-Instruction with Three-Way Review

Although three-way review can be used in any type of lesson study, it works most
effectively if combined with thinking-after-instruction. This is because, compared to
the usual Japanese three-phase class structure (introduction, main work, and sum-
mary), thinking-after-instruction clearly points to what aspects participants in lesson
study should consider in each phase. For example, in the teachers’ explanation phase,
participants should evaluate the appropriateness of instruction according to whether
students achieve deep conceptual understanding and, if not, consider what other in-
structional strategies might have been effective alternatives. In the checking compre-
hension phase, participants should consider whether the task at hand is appropriate to
allow checking of conceptual understanding for both students and teachers, and if not,
not only to point out problems but also to propose a more effective alternative. In the
deepening understanding phase, participants should similarly check whether the task
is really deepening students’ understanding. In the self-evaluation phase, participants
should evaluate students’ writing from the perspective of whether the students have
achieved appropriate understanding, and if not, again, consider what points should be
changed and what kinds of student observations might indicate that the goals of the
class have been achieved.

We will now introduce one real example of the use of three-way review in a
school. This school had been using the thinking-after-instruction approach in Japanese
language classes for two years and all lesson studies had been conducted using three-
way review. This example is taken from around the middle of the academic year, so
all of the students and teachers were by this stage familiar with both thinking-after-
instruction and three-way review. In the example, a teacher presented a 1st-grade Ja-
paanese language class in the second part of unit construction, in which the aim was for
students to learn to write sentences by themselves.

All teachers from that school and several teachers belonging to other schools
watched the students’ actual responses during class observation by standing at the
back of the classroom. As they watched, participants wrote comments on coloured
notes as described above, which they brought to the discussion. In the small group
discussion, many teachers highly evaluated the students’ responses in class, saying
that the students were really active and pleasant. At the end of this class, some stu-
dents said things like, ‘Oh, is it already time? I want to do more!!’ ‘It is OK if it is
extended until 50 minutes!’ (Japanese elementary school is 45 minutes per class). The
comments indicated that the teacher had guided the students well, and that they were
easily able to write sentences by summarising in a table, explaining what they would
write to peers before writing it, and using appropriate conjunctions. On the other hand,
some comments said that students might have more clearly understood the important
points about writing (the aim of the class). Some participants proposed alternative
ways of instruction, such as showing an example of bad writing in the checking com-
prehension phase and asking students to answer why it was not appropriate (e.g. ‘it
does not use conjunctions at all’). Those comments were shared with all teachers after
the small group discussion.

Next, a visiting academic, the first author of this chapter, commented briefly.
From the perspective of meta-cognitive awareness, the author proposed that, as an
alternative approach to those seen, the teacher could establish a flow that would help
students more consciously understand the process of writing. In more detail, the au-
thor suggested that in the teacher’s instruction phase, using material from the textbook,
the teacher could outline concrete steps or points to help students write sentences. For
example, they might first decide what to write about (decide on a specific type of car
to write about), and might then make a table and organize the material they want to
write (the function and car shape are important, so those cells should be included in
the table), explaining to peers what they plan to write based on a note or table that
they make before writing, and finally the writing phase itself. In the checking com-
prehension phase, the teacher models examples of intentionally bad student behav-
iors (e.g. starting writing without making notes or a table, or without explaining to
peers – the last strategy was emphasized in this unit as useful for students’ under-
standing and writing), and encourages students to identify inappropriate points based
on what they have learnt. In the deepening comprehension phase, information about
new material (a fire truck) is shown on a TV screen, and students are encouraged to construct sentences in groups (in a 1st-grade context like the one discussed here, a certain amount of guidance from teachers may be necessary and effective). Finally, students are encouraged to provide writing advice for other students who will write sentences in the future.

While three-way review expects the audience to propose alternatives and is usually challenging for them, using it in conjunction with thinking-after-instruction makes it easier to generate, as the design principles of the lessons are much clearer than in a typical class design. Furthermore, one of the teachers who joined in the lesson mentioned above wrote on the feedback sheet for the lesson study that ‘this style of lesson study is very effective and good. I was able to ask questions more easily and I could learn a lot even though I am not very familiar with the thinking-after-instruction approach in class. I hope to use this style of lesson study in my own school’.

4. Empirical Data from a School Using the Two Approaches

4.1 About the Site School and the National Test

In this section, empirical data are presented from a school where both thinking-after-instruction and three-way review were used in maths learning over a period of two years (this is the content of a paper presented at the International Congress of Psychology in 2016, by Uesaka, Fukaya, and Ichikawa). The targeted school is an elementary school in Shinagawa-ku, Tokyo. Before starting this educational practice, the overall achievement at this school was comparatively high, but bipolarization of achievement was considered a major problem, as teachers struggled to conduct a class that both higher- and lower-achieving students could benefit from. To address this problem, thinking-after-instruction was implemented, with the aid of the three authors of this chapter. The collaboration between the school and researchers happened because the principle of the school deeply approved of the thinking-after-instruction approach, and thus requested the three authors to support the school. The authors agreed to join this school project only once they had achieved consensus from the teachers in the school, and so the project started in April 2014 once the school principle had obtained this consensus. The authors anticipated that the following process and change would happen: First, the instructional methods used by this school’s teachers would change; second, students’ learning behaviours would change; and finally, academic performance such as in national tests would be improved. Based on these expectations, the authors designed a survey to capture these changes as well as collaboratively designing classes with teachers. We will briefly report the results of the survey in the remaining part of this section.

Over two academic years (2014 and 2015), all maths classes in all six grades were conducted using the thinking-after-instruction approach. In addition, to help all teachers share their thoughts on this approach, this school conducted lesson study with all teachers once a month, again with the participation of the researchers, and three-way review was used in those discussions. After the two-year period was over, the national test results demonstrated an improvement in the overall performance in
maths in this school. In Japan, national tests are conducted annually for all 6th-grade students in both maths and reading, including both ‘A-type’ and ‘B-type’ problems (that is, basic and applied). In the site school, as shown in Figure 6, the difference from the national average scores increased after the practice had started.

To ensure that this difference was not an outlier (a cohort effect), school and national test scores for (reading) literacy were checked, and, as shown in Figure 7, no such increasing difference between the score of this school and the national average was found. This suggests that the result for maths was not simply because the cohort taking the test was unusually good.

![Figure 6. Results of National Test in Mathematical literacy. Results of A-type problem (left) and B-type problem (right)](image)

![Figure 7. Results of National Test in Reading literacy. Results of A-type problem (left) and B-type problem (right)](image)

### 4.2 Students’ Learning Strategy Use and Teachers’ Improvements to Instructional Strategies

To examine the reasons for improved student performance in maths and the processes by which it improved, students’ learning strategy use was investigated. Several mathematical word problems were given to students (e.g. ‘Make a regular square with sheets of paper, the height of which is 12 cm and the width of which is 16 cm. Answer how many sheets of paper are necessary to make it. Explain how you get the answer using diagrams, formulae, sentences, etc.’) and the responses were analysed. From the viewpoint of learning strategy use, if students are interpreting and solving such problems conceptually, they might tend to use diagrams to understand and explain the situation, and tend to get the correct answer. On the other hand, if they do
not use any diagrams and cannot solve the problem, this may indicate that they are not using sufficient (cognitive and external resourcing) learning strategies. On this basis, the number of student responses that contained ‘correct answers with diagrams’ and ‘incorrect answers without diagrams’ were counted. The results, shown in Figure 8, indicate that over the two-year period the number of correct answers with diagrams increased and that of incorrect answers without diagrams decreased significantly. This suggests that students’ strategy use improved, and might therefore be a meaningful element underlying the improvement of the students’ maths performance on the national test.

Figure 8. Results of Students’ Strategy Use

Moreover, we also examined how teachers’ approaches to instruction changed after they started to use the thinking-after-instruction approach in class. In the site school, almost every month, teachers conducted lesson study and shared the information gained about classroom design. However, the number of classes for which all teachers participated in lesson study was limited, also limiting our understanding of changes in their teaching strategies. Thus, we explored changes in teachers’ methods of instruction by developing a new ‘lesson plan construction task’. In this task, all teachers in the school were asked to construct a lesson plan using a textbook from 2014 and one from 2015. To counterbalance, two textbook excerpts (one about the concept of line symmetry and another about calculating the area of a trapezoid) were prepared; half the teachers did the line symmetry task first (2014) and the trapezoid task second (2015) and the other half did the reverse. The teachers’ responses were coded and counted.

Figure 9 shows the several points in which the teachers’ methods of instruction changed during the period of the educational intervention. As shown in the figure, increases were observed in teachers’ adoption of collaborative learning situations, multiple-answer tasks, and consideration of points of difficulty faced by students. These changes might meaningfully underlie the changes in students’ strategy use that seemed to enhance their performance on the national test.

Finally, we looked at students’ responses to the thinking-after-instruction approach. To the question ‘What do you think about this style of class?’, more than 90%
of students responded positively, as did more than 90% of students who indicated that they did not like mathematics. More concretely, students who answered that they did not like maths said things like: ‘This style of class is good even for poorly achieving students like me!’, ‘This is very good: very easy to follow the class instruction’, and ‘I hope this style of class continues’. This is a good sign for this school, with the challenge of learning polarization that it faces, and for the broader value of these methods: both high- and low-achieving students reacted positively to this style of class.

![Graph](image.png)

Figure 9. Results of ‘Lesson Plan Construction Task’, Points that Increased were Observed

5. Conclusion

The thinking-after-instruction approach not only strikes a balance between direct instruction and discovery learning but also integrates perspectives in Japan before and after 1990. Before 1990, Japanese education greatly emphasised procedural aspects and direct instruction from teachers at all school levels (it comprised to some extent a cramming system of education). On the other hand, after 1990, the value of discovery learning was focused on and, particularly in elementary school, the focus shifted to discovery learning. The slogan ‘support rather than instruction’ became very popular, and many schooleachers, especially in elementary school, tried not to instruct students until they had found the knowledge by themselves (this was sometimes called teachers’ encouragement of thinking without instruction; thinking-without-instruction). The thinking-after-instruction approach is one example of a new trend toward integrating these two extreme ideas of previous periods.

Although Japanese teachers and researchers with whom the present authors have discussed this approach sometimes misunderstand thinking-after-instruction as a simple return to the old ways of teaching—didactic, rote learning, or cramming knowledge—this is not the case: as shown in this chapter, thinking-after-instruction comprises the integration of direct instruction and discovery learning, leading to higher-level discovery based on both a full understanding of the value of discovery learn-
ing and the deeper understanding of basic knowledge. That is, while traditional classes in Japan tried to discover the knowledge in the textbook, our approach tries to discover knowledge not obviously presented in the textbook; that is, it focuses on achieving a deeper level of knowledge and learning. Furthermore, our approach tries to help all, not only some, students articulate their discoveries and new understanding. In addition, this approach tries to improve students’ cognitive and meta-cognitive learning skills in daily subject classes. This is because this approach has been proposed by cognitive psychologists, who have a keen consciousness of the value of cognitive strategy and meta-cognitive awareness of the meaning of knowledge and students’ understanding of their own state of understanding.

Lesson study, particularly three-way review, might work very effectively when understanding this approach and designing a class with it. Some teachers who do not understand this approach well sometimes just use the four stages (teacher’s instruction, checking comprehension, deepening understanding, and self-evaluation) when designing a class based on this approach. However, it is important to understand the deep parts of this instructional idea as described above. To achieve this purpose, using three-way review in lesson study is effective, as teachers can more actively ask questions in lesson study in small groups. Furthermore, the rule whereby participants try to create alternative ideas when they find problems may contribute to developing teachers’ competencies at creating effective tasks to check and deepen students’ understanding in many situations. The data from lesson plan construction tasks designed by teachers shows this empirically. Teachers in the school never joined the lesson study dealing with the task material, but they can write more sophisticated lesson plans by experiencing three-way review as well as daily practice of thinking-after-instruction. Although the effects of three-way review alone should be examined more empirically, it can at least work very effectively when combined with thinking-after-instruction.

To conclude, let us further discuss the applicability of thinking-after-instruction in class and three-way review. We often receive questions like ‘Do you think it is necessary to use the thinking-after-instruction approach to conduct all classes?’ We do not argue that this approach is always applicable, for the following reason. We consider that in school education, two types of learning exist: mastery-oriented learning (including deep and conceptual understanding) and inquiry-oriented learning (see Figure 10). This figure is a slightly modified version of the one included in Ichikawa (2004). Mastery-oriented learning typically includes general subject learning, in which the teacher has a clear goal to achieve: inculcating certain knowledge among students. In contrast, inquiry-oriented learning means learning where students themselves set their own goals. A typical example of this type of learning is independent research, which is often assigned as a summer task in Japan. Thinking-after-instruction is, as suggested in Figure 10, a strategy for mastery-oriented learning, and it is not appropriate to apply this approach to inquiry-oriented learning. Additionally, even in mastery-oriented learning, teachers may spend time promoting proficiency at certain technical or rote tasks: calculation, or (in Japan) writing Chinese characters, or others. In such cases, thinking-after-instruction might not be a good strategy. However, we maintain that this approach is useable as a standard tool in general mastery-oriented learning, which might account for (very roughly) 80% of school education, and of which, in turn, around 80% might focus on under-
standing rather than proficiency at skills. Thus, we suggest that thinking-after-instruction might be effective across around 64% (80% x 80%) of the whole school curriculum. Although in Japan the word ‘instruction’ is perceived as somewhat negative because of the strong trend away from direct instruction since the 1990s, schools have started to come around to this more balanced perspective, and around 50 to 100 schools are currently engaged in thinking-after-instruction practice, with many schools also using three-way reviews. We hope that this idea, which emerged from the cognitive psychological perspective, will be correctly understood and will contribute to students’ development of the necessary skills to prosper in the unpredictable world of the future.

Figure 10. Two Cycles in School Education (slightly modified version of the one included in Ichikawa, 2004).

Furthermore, it might be important to consider the applicability of this approach in other cultures or countries. Although this approach was proposed in Japan and all of the current practices relating to these approaches occur in Japan, these approaches may also be effective in other cultures or countries. One of the reasons is that the issue of balancing direct instruction and discovering learning in education may be a more general topic that needs to be addressed in education all over the world. In particular, east Asian countries traditionally have a strong culture of direct instruction, so a very important topic is how to effectively integrate discovery learning. In such a situation, our proposal can provide one solution to this annoying problem. In addition, the issue as to how to achieve conceptual understanding and students’ cognitive and meta-cognitive skills in daily subject learning is very important in the context of international discussion that values competences that promote prospering in society. The combination of thinking-after-instruction and three-way review would work effectively, even in other countries. However, of course, the effectiveness of these approaches should be examined empirically. Our research groups strongly expect that not only will Japanese teachers and schools engage in these approaches but also that teachers and schools in other countries will understand the value of these approaches and that the practices relating to these approaches will thus be extended. If so, the answer to the question as to whether or not these approaches can work effectively will be demonstrated with empirical evidence. This point is one of the most important future issues for our research group.
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