Instructional Strategies for Promoting Joint Thinking and Dialogue among Learners by means of Interactive Whiteboards*

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The purpose of this study is to examine the interactions in the learning activity of learners that make presentations using the interactive whiteboard, and to construct a model for instructional strategies adopted by teachers to promote thinking and dialogue among learners. Through a field research by videotaping the learning scene, we conducted an analysis of the speeches and behaviours of the learners and teachers. As a result, several categories of teachers' instructional strategies have been formed; Set up a framework for dialogue; Instruct an explanatory method; Demonstrate a model; Respond to the student's explanation; and Ask questions that promote thinking. Among the components that constitute these categories, we identified some phenomena accompanying characteristic conducts and actions in leveraging the use of the interactive whiteboard: Prepare (= capture/ enlarge) the display screen ; Advise them to write in explanatory notes ; Advise them on the usage of the marks and signs ; Change colours for them to make a comparison ; Instruct them to save the written-in notes ; Demonstrate model standing positions ; and Demonstrate model motions and gestures.

Key words: Interactive whiteboard, Teaching strategy, Lesson study, Qualitative Research, Thinking skills, Dialogue

1. INTRODUCTION

Recent years we have seen an upsurge of studies on use of the interactive whiteboards in education, and find a diversity of approaches: 'A Study on the Research into the Teacher's Intention in Leveraging' (Kobayashi et al. 2007), 'A Lesson Study Leveraging the Interactive Whiteboard' (Ishikura et al. 2007; Nakagawa and Nakahashi 2009), 'Development of External Interface' (Ota et al. 2007), 'Modelling the Leveraging Method' (Denshi Kokuban Katsuyo Koka Kenkyu Kyogikai 2008), etc. This underscores the expectation for the interactive whiteboards as an educational media that opens up new educational potentials, and goes beyond the traditional notion of a mere device for presenting purposes.

The interactive whiteboard allows its users to easily present static images and motion graphics, as well as to write in, correct and save the screen, without having to be aware of the computer's existence. Presenters can operate it in front of the screen and draw audience's attention (Shimizu 2006). Because it is easy to perform functions that are difficult on the traditional blackboard, teachers now spend less time in preparation and hence are able to deliver lessons interactively.

Fig. 1. Activity in which a learner explains an idea

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A method in which one student explains his/her idea to others is one of the ways that make good use of unique features of the interactive whiteboards (Fig. 1). The interactive whiteboard is deemed to contribute to ‘the enhancement of students’ ability to think, judge and express’, which is stressed in the Japan’s new course of study, by simplifying the learning activity and facilitating dialogue and interaction among the learners. Inagaki et al. (2008) reported that, compared to the case where an interactive whiteboard was not used, a presentation with it while writing notes on it scored better audience’s comprehension. Therefore, it is expected that more and more learning activities will introduce interactive whiteboards in explaining ideas.

However, perhaps partially due to the fact that interactive whiteboards have not been installed many schools yet, no crystallized instructional strategies for teachers in such a context seem to exist. Therefore, to disseminate effective teaching strategies once installation of the interactive whiteboards picks up momentum, detailed analysis of the cumulative classroom practices and studies to model normative instructional strategies are required.

Based on the aforementioned considerations, the purpose of this study is to model the instructional strategies used by teachers with certain experiences by using the interactive whiteboard in ‘a learning activity in which the learners present their ideas by using interactive whiteboards.’

2. RESEARCH METHOD

2.1. Features of the Research Method

In terms of previous studies on instructional strategies, results of the classroom analysis concerning teaching skills and category analysis have been reported in our academic society as well. For instance, Kitao et al. (1988) defined items concerning the teacher’s behaviour in classes as teaching skills, and further, pointed out the differences between seasoned teachers and interns, as well as changes between the former and the latter. The category system for communication analysis in the classroom has also witnessed to many developments, which are applied in classroom analysis and the education of teachers (Nishinosono 1981; Kogamei and Inoue 1979, etc.). Recently, Kishi et al. (2008) reported that teachers’ speeches regarding their ‘direction’ may trigger an interactive negotiation between a teacher and pupils in the classroom.

These studies focused on elucidating the teachers’ teaching behaviour towards the learners, as well as the structure of the class; however, they did not consider influence on the teachers’ instructional strategies for the phenomenon of interaction between teachers and learners, or among the learners themselves, with new technologies such as interactive whiteboards. Hence, this study adopts the ‘qualitative research method with the object of explaining the meaning of the social phenomenon (i.e. interaction in the classroom) while taking utmost care not to disturb the natural state’ (Merriam 1998), for analysing the previous practices with regard to leveraging interactive whiteboards, and for deriving normative instructional strategies. It is based on the assumption that, in an area of research where there is a dearth of theoretical stock of how a new technology may impact social interaction, the generalization of a theory based on qualitative data gleaned from a natural state would be highly significant for yielding insight applicable to the practical education scene.

As stated above, there have been reports on diverse cases of practices that use interactive whiteboards, as well as researches studying teachers’ intention in using it, but there have not been sufficient studies that qualitatively analyse the interactions in the classroom and develop a teachers’ model of instructional strategies designed to promote dialogue and thinking among learners.

2.2. Research Object

The object of this study is a learning activity whereby a student explains an idea using the interactive whiteboard. Further, we decided to record and analyse the practices of three teachers with over three years’ experience of using interactive whiteboards on a day-to-day basis in the classroom, particularly in dialogue activities. Table 1 outlines the research object: the teachers’ years of experience, number of years using interactive whiteboards and the learner’s grades.

Table 1. Outline of the Research Object

<table>
<thead>
<tr>
<th>Practice</th>
<th>Learner’s Grade</th>
<th>Teacher’s Years of Experience</th>
<th>Years of Interactive Whiteboard Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice A (Japanese)</td>
<td>4th Grade</td>
<td>31 years</td>
<td>4 years</td>
</tr>
<tr>
<td>Practice B (Social Studies)</td>
<td>4th Grade</td>
<td>17 years</td>
<td>6 years</td>
</tr>
<tr>
<td>Practice C (Arithmetic)</td>
<td>6th Grade</td>
<td>12 years</td>
<td>3 years</td>
</tr>
</tbody>
</table>
2.3. Outline of Practice

Next, we laid out the practice outline of the research object. Although the subjects and study contents were not the same, they were uniform in their practice of explaining one's idea logically based on the images shown on interactive whiteboards.

(1) Practice A: 4th Graders / Japanese

Practice A was done in a Japanese class where illustrations were drawn based on the contents of poems (letter info). The teacher captured the students' illustrations onto an interactive whiteboard, displaying them on a large screen. The student who drew the illustrations then explained the parts of the poems expressed in the illustrations.

(2) Practice B: 4th Graders / Social Studies

Practice B was done in a social studies class where learners were to identify and state the discrepancies between the illustration depicting life in the olden days displayed on an interactive whiteboard and today's lives. It is a practice to read and work out the info from the illustrations, mark the parts different from contemporary lives, and explain by focusing on them.

(3) Practice C: 6th Graders / Arithmetic

Practice C was done in an arithmetic class where the volume of an L-shaped 3-dimensional (3-D) shape must be sought. To calculate the volume from the info on the given figure and length of the sides, one must split the 3-D shape and construct a formula. Depending on where the split is, there are diverse solutions. The practice involved the learner explaining the solution to others in a comprehensible manner.

2.4. Procedure

We recorded the learning scenes and conducted an analysis of the utterances and behaviours of the learners and teachers. Specifically, we gathered data and analysed them according to the following steps:

(1) Record the class on video.
(2) Extract images of the scenes in which the interactive whiteboard was used.
(3) Take notes on the speeches and actions of the teachers and learners.
(4) Segment the written data into the smallest unit possible for interpreting the occurring phenomenon.

(5) Label each segment.
(6) Compare multiple labels to generate categories.
(7) Compare multiple categories and identify the interrelations, so as to visually model the teachers' instructional strategies.
(8) Perform further exploration by citing instances to determine the type of instances that support the interrelations among the categories entailed in the diagram organized as the model.

We shall now describe the coding procedure of generating categories.

First, we compared multiple data with the same label, checking them against the context of the original data. We determined whether they are similar phenomena and used it as the criterion. If they share similarity, we grouped them together under the same label. Conversely, if they were judged to be disparate phenomena, we categorized them separately under different labels. By the same token, we compared multiple data with different labels and, when judged to be similar phenomena, integrated them into one group under a shared label.

Next, in case the phenomena had different labels in concrete terms but could be ruled as being similar in terms of a highly abstract concept, we grouped them together under the same category name. We followed the same procedure as with the label in determining whether to classify the data under the rubric of one category, by checking them against the context of the original data.

In this way, we classified the phenomena by labelling them, repeatedly comparing the original data and confirming consistency between the labels and the categories. In the process, the names of the labels and categories were adjusted accordingly. We made a special effort to ensure validity by having Author 1 conduct the coding and Author 2 conduct the checking. In this paper, we denote label by underlining it and category by making it bold.

3. RESULTS AND REFLECTIONS

3.1. Results of Coding

We conducted an analysis of the presentation scene in Practice A in accordance with the aforementioned procedure. Based on the labels conferred on the phenomenon, we created categories, and diagrammed (modelled) the interrelationships among these categories. Seven
categories were generated at this point: Set up a framework for dialogue; Explain while showing the screen; Instruct an explanatory method; Demonstrate a model; React positively; Respond; and Ask questions that promote thinking.

Next, we analysed the presentation scene in Practice B, and attempted to determine whether different categories were to be created in comparison with the categories of Practice A. By comparing the two practices, new categories were generated. We modified the model accordingly. At this point, we added three new categories: Explain while writing in notes; Ask the teacher; and React negatively.

Furthermore, when we analysed the presentation scene in Practice C as the object of ongoing comparison, no new categories were created beyond foregoing categories derived from Practices A and B, and Practice C fit the model as well. We determined that we had successfully derived a certain pattern regarding teaching strategies.

The model diagrammed in the analysis of Practice A was obtained by deleting the following 3 categories from the final model to be presented later as Fig. 2, and, as such, it did not affect the basic flow: Explain while writing in notes; Ask the teacher; and React negatively.

Finally, the analysed data consisted of 3 practices and 21 presentation scenes, where the coding was administered to 303 segments. The end result was that 51 labels were assigned and 10 categories were created. As a concrete example, we extract partial data from Table 2, and show the unit at which the segmentation was done, as well as the labels that were conferred in order to generate the categories. Hereafter, "S" refers to the presenting learner, "A" the audience learner and "T" the teacher.

3.2. Details of the Categories

We proceed to a detailed account of each category.

(1) The teacher sets up a framework for dialogue

The teacher sets an assignment and encourages a statement from the learners, while at the same time appoints (or have the learner to appoint another) and give guidance on how to permit presentation. The teacher also calls for attention from the audience, put them in a listening mode, thus setting up a framework for dialogue. The teacher, so as to set up a framework for dialogue, prepares (capture/enlarges) the display screen on the interactive whiteboard for the purpose of comprehensible explanation with visual aid, such as textbooks and worksheets. When a learner is unsuccessful with the explanation, the teacher, instead of immediately providing an answer, sometimes invites support, by urging other learners to seek a complementary explanation or an alternative opinion.

(2) The presenter explains while writing in notes

The learner puts the interactive whiteboard's functions to use, such as write in letters and formulas corresponding to the images and zoom in (mark with circles and underlines). In the process, there are scenes where they make corrections and start over, that is, erase the written-in notes. In this way, the presenter makes it a point to explain while writing in notes on the interactive whiteboard so as to ensure that the audience understand what he or she is explaining by contriving to show his/her ideas.

(3) The presenter explains while showing the screen

During presentation, the learner does not always explain while writing in notes on the interactive whiteboard; they often explain while showing the screen. The presenter stands by the interactive whiteboard to set up a situation where the audience listen while paying attention to the interactive whiteboard, and at the same time express own opinion. The presenter can thus check with the audience if they agree with his/her opinion by asking 'Are you okay with this?', as well as express his/her intention to close the presentation by stating 'This concludes my presentation.'

(4) The presenter asks the teacher

While sometimes a learner may request to speak, there are also occasions when they, upon being called, express a complaint saying 'I wish you had asked for some other question' or when they are lost for words, sunk in thought (not knowing the answer) in silence. Such situations can be avoided if the learner asks the teacher in the following manner: ask about the explanatory method; ask about the content; and ask to request permission to close the presentation so that he/she may return to the seat.

(5) The audience reacts positively

When audience learners react to the presentation and the teacher's response, there emerges an interaction in the form of thinking and
Table 2. Labels and Categories in Practice B (T: Teacher, A: Audience, S: Speaker)

<table>
<thead>
<tr>
<th>Utterance / Situation</th>
<th>Label</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>(The pupil is replaced. The new pupil blunderingly draws a circle on the monitor)</td>
<td>Zoom in (Mark with circles and underlines)</td>
<td>Explain while writing in notes</td>
</tr>
<tr>
<td>Let’s see, is this where it is different?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oh, that’s a good point. You have an eye for detail.</td>
<td>Comment for the idea</td>
<td>Respond</td>
</tr>
<tr>
<td>Keep your comments coming, people. I’m sure there are a lot more. I think that your</td>
<td>Encourage a statement</td>
<td>Set up a framework for dialogue</td>
</tr>
<tr>
<td>grandpas and grandmas had these experiences too.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark it with circles. Good.</td>
<td>Advise them on the usage of the marks and signs</td>
<td>Instruct an explanatory method</td>
</tr>
<tr>
<td>Okay, the difference is that…? (Request the learner to repeat the same words.)</td>
<td>Make them speak in a stereotyped manner</td>
<td>Instruct an explanatory method</td>
</tr>
<tr>
<td>Well, let’s see, the difference is the… The stone mortar?</td>
<td>Express own opinion</td>
<td>Explain while showing the screen</td>
</tr>
<tr>
<td>We came across this one yesterday. What is it called again?</td>
<td>Ask questions to deepen the explanation</td>
<td>Ask questions that promote thinking</td>
</tr>
<tr>
<td>Stone mortar! Stone mortar!</td>
<td>Speak in response to an explanation or a question</td>
<td>React positively</td>
</tr>
<tr>
<td>Right, a stone mortar. How is it different from today?</td>
<td>Ask questions to deepen the explanation</td>
<td>Ask questions that promote thinking</td>
</tr>
<tr>
<td>Nowadays, we don’t have a stone mortar at home.</td>
<td>Express own opinion</td>
<td>Explain while showing the screen</td>
</tr>
<tr>
<td>No, we don’t. How do we do it without this?</td>
<td>Ask questions to deepen the explanation</td>
<td>Ask questions that promote thinking</td>
</tr>
<tr>
<td>(Silence)…</td>
<td>Sunk in thought (not knowing the answer)</td>
<td>Ask the teacher</td>
</tr>
<tr>
<td>What do you do with this stone mortar when you need powder?</td>
<td>Ask questions to deepen the explanation</td>
<td>Ask questions that promote thinking</td>
</tr>
<tr>
<td>We go to the supermarket.</td>
<td>Speak in response to an explanation or a question</td>
<td>React positively</td>
</tr>
<tr>
<td>…and buy it?</td>
<td>Express own opinion</td>
<td>Explain while showing the screen</td>
</tr>
<tr>
<td>Yes, it’s sold at the supermarket. Various types of packets. Yes, right. If you</td>
<td>Explanation to deepen the explanation</td>
<td>Ask questions that promote thinking</td>
</tr>
<tr>
<td>want to do it yourself, you can get something like an electric mixer. The type of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mixer you use to grind sesame seeds and beans. Okay, any other comments?…That’s it?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, let’s keep them coming.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

dialogue concerning the learning content. For instance, the audience may react in the following manner: clap, smile and express an opinion about the displayed image. Or, they may express consent to an idea they also harbour, be convinced by an explanation, or engage in a monologue by verbalising their thoughts, as opposed to stating feedback to the speaker. Furthermore, behaviours that may deepen the level of learning are also recognized, such as request to speak to share their view and speak in response to an explanation or a question. These are some instances of react positively.

(6) The audience reacts negatively
Conversely, when the presenter’s voice is too soft or the explanation is unclear, the audience may express doubt or state something to supplement the explanation. In addition, some go beyond the study content itself and expressed complaints about the method of explanation. These are the examples that audience react negatively/ state negatively.

(7) The teacher instructs an explanatory method
While letting the learners use the interactive whiteboard to explain their ideas, the procedure where the teacher instructs an explanatory
method was repeatedly used in leveraging the interactive whiteboard to the learner: make them speak in a stereotyped manner; advice on their volume; advise on their standing positions; advise them to write in explanatory notes; advise them on the usage of the marks and signs; and change colours for them to make comparison. There is also a scene where the teacher instructed the learner to save the written-in notes for later review.

(8) The teacher demonstrates a model
The teacher does not necessarily give guidance on an explanatory method all the time to the learner whose explanation does not go well. Depending on the circumstances, the teacher demonstrates a model, such as demonstrate model standing positions or demonstrates model motions and gestures while they review or complement the learner’s explanation.

(9) The teacher responds
In the course of the presenter’s explanation and comments, the teacher would show consent, respond, commend for the idea, confirm, correct or provide an answer or give permission to finish. There is occasionally a scene where the teacher tells the learner to start over by rearranging the contents logically for better delivery. When there was a complaint from the learner, the teacher would soothe them. It is revealed that the teacher would respond, through constant intervention so as to ensure that the learner would be able to finish and also that there would be a dialogue between the learner and the audience.

(10) The teacher asks questions that promote thinking
The teachers assist the understanding and thinking of the audience by supplementing and developing the presenters’ contents through explanation to deepen the explanation and by asking questions to deepen the explanation to induce the audience to think. Among learners that are not experienced in explaining their own thoughts regarding the study content, dialogue does not emerge spontaneously. Therefore, when a teacher asks questions that promote thinking in response to the students’ speeches, the teacher plays an important role.
It should be noted that in this study, we used the phrase ‘ask questions that promote thinking’, and not ‘question-raising’, which is a similar concept. According to Toyoda (2005), ‘question-raising means the act of raising questions on the part of a teacher during class. Narrowly defined, it refers to the teacher’s questions designed to facilitate the pupils’ thinking activity along with teaching content and organizing learning activity in which they actively grasp the subjects. The origin of ‘question-raising’ in school education may be traced back to the catechism question-raising as a tool for infused memorization of the articles of faith. Question-raising of this type demanded the pupils to answer ‘standard answers’ taught by the teacher and/or written in the textbook. In contrast, with the emergence of a new education system that holds that studying is not brought to perfection in dutifully repeating and memorizing what the teacher teaches, because children have adequate ability to think for themselves. Hence, a new concept of question-raising emerged, stressing the need for ‘question-raising to facilitate their independent thinking and discovery’ (omitted hereafter). The shift in concept of ‘question-raising’, as mentioned above, has a rather broad meaning. Therefore, we chose to use the more narrowly defined phrase ‘ask questions that promote thinking’ instead.

3.3. Modelling the Instructional Strategies

We compared the categories thus formed and modelled their interrelationships visually in Fig. 2. In particular, phenomena that are accompanied by conducts and actions associated with the leveraging of the interactive whiteboard have been marked with labels. The comparison among the categories was conducted by checking the context, referring to the original data recording ‘the learners’ utterances and ‘circumstances.’ This model describes the flow of the learners’ activity and reaction, as well as the teachers’ instructional strategies in response.

In the learning activity where a learner uses the interactive whiteboard to explain an idea, the teacher sets up a framework for dialogue, for example, prepares (= captures / enlarges) the display screen on the interactive whiteboard. The presenter explains their thoughts leveraging the interactive whiteboard. Hence, he/she stands by the interactive whiteboard and explains while showing the screen. Some presenters repeatedly write in letters and formulas on the images displayed on the interactive whiteboard, zoom in and erase the written-in notes, all of which fall in the category of explain while writing in notes. If there is an issue, they may ask the teacher.

When the speaker delivers a good presentation, the audience may react positively. The teacher may effectively respond and ask questions that promote thinking in response to the statements by the learner, so as to guide them to deeper learning. Once an in-depth learning is attained, the speaker may then engage in dialogue with the other students or proceed to the next activity.

When a student fails to deliver a successful presentation, the audience may react negatively. In response, the teacher moves to instruct an explanatory method on leveraging the interactive whiteboard: advise them to write in explanatory notes; advise them on the usage of the marks and signs; change colours for them to make comparison; and instruct them to save the written-in notes. At this point, the teacher may get the presenter to start over or may replace him/her with another learner.

At other times, the teacher may take the initiative to show a model and supplement the presenter’s explanation and deepen the level of learning: show an example on positioning themselves; and showing an example of motions and gestures.

Therefore, the teacher works on facilitating the thinking and dialogue among the learners by means of instructional strategies: set up a framework for dialogue; instruct an explanatory method; take the initiative to show a model; respond to the student’s explanation; and ask questions that promote thinking.

The above discussion suggests that the method to leverage the interactive whiteboard in presentation does not come naturally to the learner; it is acquired gradually through practices with the teacher’s guidance. Such guidance would be constantly provided in the process of the presenters’ speeches.

The entire categories may not always appear in accordance with the flow chart. For instance, when a student is not being successful in delivery, his/her teacher may decide to instruct an explanatory method without waiting for negative feedback from the audience.

3.4. Concrete examples concerning the Teachers’ Instructional Strategies

We now attempt to substantiate the interrelationships among the categories encapsulated in the diagram organized as a model.
by concrete examples. We shall focus on the parts where the flow diverges, so as to observe the decisions that were made by the teachers. We will explore the teachers’ normative instructional strategies required for the practice to explain ideas by leveraging the interactive whiteboard.

(1) Case of instructing an explanatory method

In Practice C, where an explanation was given on how to obtain the volume of the L-shaped 3-D shape, the following were the interactions.

<table>
<thead>
<tr>
<th>T:</th>
<th>Number 1, how was this figure manipulated to yield the outcome? ○○, you have to keep silent. Okay, then, let’s start with □□. Come forward one by one, and write it out. You may choose any coloured pen available. Make sure there is no overlap.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S17:</td>
<td>(Draws an additional line.)</td>
</tr>
<tr>
<td>T:</td>
<td>Okay, tell us that you are going to start with that formula. Good, write that out, too.</td>
</tr>
<tr>
<td>S17:</td>
<td>(Pointing to the interactive whiteboard, writes in the air.) 10 × 4 × 15 plus 10 × 4 × 5</td>
</tr>
<tr>
<td>T:</td>
<td>How is it coming?</td>
</tr>
<tr>
<td>A:</td>
<td>Can’t hear.</td>
</tr>
<tr>
<td>T:</td>
<td>Can you bring up your volume?</td>
</tr>
<tr>
<td>S17:</td>
<td>(Explains verbally without touching the interactive whiteboard.) 10 × 4 × 15 plus 10 × 4 × 5 equals 800.</td>
</tr>
<tr>
<td>T:</td>
<td>Let’s do it one more time, this time using a pen.</td>
</tr>
<tr>
<td>A:</td>
<td>Too fast!</td>
</tr>
<tr>
<td>A:</td>
<td>You have to tell us what you’re doing. We can’t figure out when you just say the calculations.</td>
</tr>
<tr>
<td>T:</td>
<td>You should write it on the board. It’s easier to follow.</td>
</tr>
<tr>
<td>T:</td>
<td>Shall I get you some help? Any volunteers?</td>
</tr>
</tbody>
</table>

In this case, the presenter made use of the interactive whiteboard up to the drawing of the additional line, but did not write in beyond that point, thus failing to explain in a way comprehensible to the audience. It resulted in the complaints from the audience, such as that the voice was too soft and that the explanation was insufficient. Regarding the audience learner A, deeper learning towards the studying material via thinking and dialogue, possibly was not attained.

Further, the teacher advised the presenting learner that ‘speaking louder and writing down the thoughts into letters would enhance comprehension.’ Moreover, by recruiting a supporter who would demonstrate a different mode of explanation, the teacher was attempting to get the original presenter to learn the proper explanatory method.

The above case proves that merely knowing the write-in function does not guarantee a successful presentation. The learner has to learn through actual practices where to focus, what to write in and how to explain while using it. This also suggests that the instructional strategies that the teachers apply and the way they design the class accordingly are critical for the practices to explain an idea leveraging the interactive whiteboard.

(2) Case of demonstrate a model

In Practice A, where illustrations were drawn from poems and the correspondence between the text and the illustrations was explained, the following were the interactions.

<table>
<thead>
<tr>
<th>T:</th>
<th>(Changes the screen and shows S01’s illustration.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:</td>
<td>‘That’s scary!’ ‘Is that a frog?’ ‘Hey, that’s not supposed to be a frog, is it?’ ‘It seems like it.’</td>
</tr>
<tr>
<td>T:</td>
<td>Come on up.</td>
</tr>
<tr>
<td>S01:</td>
<td>(Stands up.)</td>
</tr>
<tr>
<td>T:</td>
<td>(As S01 is showing his/her back to the audience, the teacher turns him/her around, facing A.)</td>
</tr>
<tr>
<td>S01:</td>
<td>(In inaudible voice) Let’s see, the poem says that a big spider is moving along…</td>
</tr>
<tr>
<td>T:</td>
<td>○○, Did you catch that?</td>
</tr>
<tr>
<td>T:</td>
<td>(Standing in front of the screen, demonstrates a model for presentation.)</td>
</tr>
<tr>
<td>T:</td>
<td>(Pointing to the spider on the screen) A big spider is moving along. (Pointing to the frog on the screen) And the frog? Is it crying because it’s hunted down?</td>
</tr>
<tr>
<td>A:</td>
<td>But the frog can run away because it’s quick.</td>
</tr>
<tr>
<td>T:</td>
<td>Hmm, is this what the poem is about? Well, thank you.</td>
</tr>
<tr>
<td>T:</td>
<td>Okay, then, ○○.</td>
</tr>
<tr>
<td>S02:</td>
<td>(Comes forward.)</td>
</tr>
<tr>
<td>T:</td>
<td>(Changes the screen and shows S02’s illustration.)</td>
</tr>
<tr>
<td>A:</td>
<td>Wow, cute!</td>
</tr>
<tr>
<td>T:</td>
<td>(Moves S02 to the side of the screen so the audience can see it.)</td>
</tr>
<tr>
<td>S02:</td>
<td>Well, (pointing to the area of the sky) I thought that it is a cloud in the vast sky. (Pointing to the sentence) Since it says ‘Oh, it smells good,’ I thought it couldn’t be referring to an insect, such as a spider. (Pointing to the area of the sky again), so I thought it must be about the cloud in the sky.</td>
</tr>
<tr>
<td>A:</td>
<td>That makes sense.</td>
</tr>
<tr>
<td>T:</td>
<td>Well, we’re not quite there yet.</td>
</tr>
</tbody>
</table>
In this instance, the teacher captures the images in order to set up the framework for dialogue. The intention seemingly was to prevent the presenter from failing in operating the interactive whiteboard prior to presentation, so they may concentrate on the explanation.

After the presentation by the first student (S01), the teacher offers guidance on the standing positions, direction of speech and volume of the voice. Here, instead of forcing the student to start over, the teacher demonstrates a model and supplements the student’s presentation (Fig. 3). Through this approach, the teacher facilitates the audience’s understanding and gets them to think of the difference from the interpretation of the second presenter (S02).

In the subsequent presentation by S02, the learner delivers an explanation while leveraging the interactive whiteboard by mixing gestures and images, thus winning understanding from the audience.

This case showed that, when faced with an unsuccessful learner, the teacher may react by demonstrating a model and supplementing the explanation so as not to disturb the learning flow, instead of constantly instructing the explanatory method.

(3) Case of responding, and asking questions that promote thinking

Next, we turn to a portion of Practice B where ‘the differences between today and the past’ are explained using illustrations.

S07: Let’s see, the difference in today is, here, the horse.
T: A horse.
S07: Yes.
A: That’s true.

A: Yeah, that’s true.
T: Okay, then, can you elaborate on how it’s different from today?
S07: Nowadays, we don’t have horses at home.
T: No horses? (Laughing) Indeed, no horses.
A: (All laugh.)
T: Okay, so why did they keep horses back then?
A: I got it!
A: I know! I got it!
T: Oh, so you got the answer? O0, go ahead.
A: Yes, they were needed for something in the field… like for work.
T: Excellent! Nowadays we have tractors, tillers and other machines that go ‘Vroom!’ and do the job for us, but in those days there were no such things. Horses were used to pull heavy equipment to plough the ground. They also carried loads. That’s why horses were important animals in place of today’s tractors and trucks. That’s the reason they were kept at home. Got it? Good. Let me hear more answers.

In this instance, the audience is quick in responding to the presenter’s answer. They notice something in the other’s explanation, which they had failed to perceive initially regarding visual info. Furthermore, the teacher’s questions triggered the audience to speak out, and the teacher’s supplementary explanation deepened the level of understanding. From this, we learn that the teacher’s role in ‘ask questions that promote thinking’ significantly deepens the level of comprehension, and that it is not sufficient to let the presenter ‘explain their ideas by leveraging the interactive whiteboard.’

4. CONCLUSION

In this study, we examined the phenomena deriving from the learning activity where learners explain their idea by leveraging the interactive whiteboard and modelled the instructional strategies adopted by the teachers to facilitate thinking and dialogue among the learners. As a result, we formed several categories for the teachers’ instructional strategies: set up a framework for dialogue; instruct an explanatory method; and demonstrate a model, as well as respond and ask questions that promote thinking in response to the learner’s presentation. These, in turn, are comprised of constituent factors which are phenomena accompanied by characteristic conducts and actions in the process of leveraging the interactive whiteboard: prepare (= capture/enlarge) the display screen; advise them to write
in explanatory notes; advise them on the usage of the marks and signs; change colours for them to make comparison; instruct them to save the written-in notes; demonstrate model standing positions; and demonstrate model motions and gestures.

Under such guidance, some phenomena on the part of the learner were identified as characteristic conducts and actions involved in the act of using the interactive whiteboard: stand by the interactive whiteboard, write in letters and formulas in the images, zoom in and show, and erase the written-in notes.

However, this does not mean to say that the numerous general instructional strategies of the traditional style have been replaced by the usage of interactive whiteboards, as we have listed the categories by showing various labels in our study. For instance, the idea of ask questions that promote thinking was taken up by Kishi et al. (2008) as one of the ‘engaging’ statements; however, they did not deal with the practices of using interactive whiteboards. But such instructional strategies have a significant meaning in the classrooms where interactive whiteboards are used. This implies that we should not be singularly focused on exploring ‘What new instructional strategies are to be added by the use of interactive whiteboards’. Rather, the present study points to the conclusion that a balanced guidance to facilitate thinking and dialogue among the learners are obtained when the instructional strategies based on the characteristic conducts and actions during the usage of interactive whiteboards is combined and reinforced by the traditional instructional strategies.

Recently, the DeSeCo project of OECD identified three categories of key competencies required in a society: ‘ability to act autonomously’, ‘ability to make reciprocal use of tools’, and ‘ability to interact with heterogeneous groups (Rychen and Salganik 2003). The idea of ‘Zest for Living’ adopted by Japan’s new course of study (March 2008) is not in conflict with this concept of key competencies. To realize ‘Zest for Living’, it would be essential to cultivate a cooperative problem-solving ability, and it stands to reason that some aspects of learning experiences will be leveraged towards this end: thinking by oneself in grasping a problem and drawing a conclusion through dialogues with others. The school education, in particular, is expected to nurture the competencies of communication, consideration, judgment and expression in this process.

Based on the analysis of the learning activity in this study, we can conclude that the use of interactive whiteboards is deemed to contribute to the development of such academic competencies, but that the introduction of devices themselves does not guarantee improvement in the quality of education.

For the learners to be able to engage in in-depth discussion by using interactive whiteboards, they would need practical learning experiences and guidance. Further lesson studies must be done zeroing in such instructional strategies. Although the insight gained from this study is of a limited nature, it does point out that importance.

5. PROBLEMS AND PROSPECTS

The findings of our study, which were derived from the analysis of multiple disparate cases, may be applicable to other cases under similar conditions as the object of the analysis. However, depending on the development level in the learners, their experience with interactive whiteboards and the functional development of the interactive whiteboards, the framework may have to be adjusted. This is the limitation of this study, as well as a point for future research.

Moreover, the practices targeted as the object of research in this study were not spontaneous dialogues among the learners; the teachers took the initiative in making statements and controlled the flow of the discussion. It is to be projected that, henceforth, the learners who experienced these practices will become capable of autonomously engaging in dialogue by themselves, while using interactive whiteboards. Further research is therefore required to explore the role of interactive whiteboards in such developmental processes and applications, and also the type of instructional strategies that may emerge in response.

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REFERENCES

Instructional Strategies for Promoting Joint Thinking and Dialogue among Learners by means of Interactive Whiteboards