

Chinese Children' Drawing in Science Class

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Abstract. Numerous studies have shown that the use of drawing in primary school classrooms is effective. Drawing helps children understand scientific concepts, express their ideas, and communicate. However, the use of drawing in classrooms in China is limited. In this qualitative exploratory study, we examined the role of drawing in a primary school science classroom in China. The teacher used drawings at all stages of the implementation of the teaching, and provided the 12 students of the class with drawing options when they were asked to complete tasks. Before and after a teaching intervention, we administered questionnaires and conducted interviews with students. Through analysis of the students' drawings and information from a survey and interviews, we found that the students all subsequently chose to complete the tasks by drawing independently and, over time, the teacher reported that the students were able to complete the tasks faster and better. Through drawing, the students also behaved more actively during group communication activities. In addition, we found that the drawing examples provided by the teacher greatly influenced the students' drawings. These findings provide support for the effectiveness of drawing in primary school science classrooms in China. However, we also found some problems in the use of drawing and we propose some ways for solving such problems.

Keywords: Science education, Children' drawing, Chinese science class.

1 Introduction and Theoretical Background

Drawings are visual representations that belong in the category of "diagrams", as broadly defined in this forum. According to science education research, drawing can enhance students' conceptual understanding [1], their ability to communicate knowledge [2], and their ability to critically use and interpret visual media [3]. Also, in teaching, the examples teachers provide have a large impact on how children represent science content in their drawings [4]. Apart from enhancing students' participation in learning activities and helping them learn to represent information, drawing can also be used as a learning strategy to help students learn and communicate more effectively [1]. Drawing is not only a way to record and express information, but also a learning method to promote reasoning, design conceptualization, modeling, and other advanced cognitive development [5]. However, drawing is not necessarily appropriate all the time in the science classroom, and if students are not prepared or the teacher does not provide appropriate help, the students can end up performing worse, thus discouraging their

learning efforts. Therefore, the use of drawing requires the teacher to choose appropriate topics in which to implement it [6].

Previous work by Areljung and colleagues [4], Westlund [7], and Kress and van Leeuwen [8] have proposed various ways by which children may represent science content, including representations of such content as theory, natural experience, event, art, person, attitude evoking, and cultural heritage. In representing science as *theory*, the science content gets divided and depicted in terms of its analytical units (from the scientific point of view), using minimalist shapes, without much detail and with little if any coloring. As *context*, the content is placed in a setting where it is likely to be found (often based on the child's experience), accompanied by details that integrate the content into that setting. As *event*, the drawings convey movement or processes (what happens), and visual techniques such as alignment, contrast, proximity, and symbols (e.g., arrows, lines) are often – but not always – employed. As *art*, the child represents the content using vibrant colors, decorations, patterns, and various shapes that can make that content visually arresting or interesting. In representing the content as *person*, the drawings may include the face and body or parts of it, and human characteristics – even when the content is non-human. As *attitude evoking*, the drawing of the science content evokes attitude and emotions toward it through the use of emoticons and other symbols that convey meaning of the child's understanding of that content. Finally, as *culture*, the drawing includes visual elements from culture in its broadest sense, such as societal practices, religion, folklore, and pop culture.

Numerous studies have shown the role of drawing in science classrooms. However, the existing studies on the science classrooms of Chinese primary school students have only shown that teachers use drawings and images to help students understand abstract knowledge. As far as we are aware, there are no studies that have examined the current situation of Chinese primary school students' drawing in science classrooms, including how their drawings may change following instructional interventions.

Based on this situation, in the present study, the main question we tried to answer was: How would primary school students respond when a teacher provided more drawing examples during science class? We were particularly interested in findings out any changes in (1) the students' ways of representing science content in class tasks and (2) their engagement in learning tasks and communication with peers; and (3) whether the kinds of examples the teacher used influenced the students' drawings.

2 Method

The participants were 12 students in the 4th grade in Xinghe Experimental School Pingfang Branch, Beijing, China (mean age = 10 years, females = 9). The teacher was a science teacher, 55 years old, female. All necessary permissions from the school administration, the grade teachers, and the students and their parents were sought and obtained prior to the conduct of the study. The drawing intervention was incorporated as part of the regular science instruction to be provided to the class.

The study was conducted over 7 lessons, each of which was 45 min in duration. The topics covered in those 7 lessons were comparable: "sound" in lessons 1–3, and "air" in lessons 4–7. Prior to the start of Lesson 1, the students were given a questionnaire to

obtain demographic details and their beliefs and perceptions about the use of drawings. A pre-intervention task was given during the first half of Lesson 1, after which the teacher already provided the intervention (i.e., also during Lesson 1) and gave the first post-intervention task, which was the same as the pre-intervention task (i.e., “Describe the sounds that you hear in your daily life”).

The teacher provided the science class instruction using 5 steps. **Step 1.** Introducing topics and asking questions (to establish links between old and new knowledge). **Step 2.** Brainstorming (Assigning class exercises on the science topic. Plus, this step could change into designing an experiment depending on the goal of teaching.). **Step 3.** Exploring (Showing a video; the videos were about the new knowledge being covered in class. After the students watched the video, the teacher would ask relevant questions, requiring the students to answer in their preferred way, through drawing or writing). **Step 4.** Communicating and displaying (students engage in group discussion, exchange of views, improving their work then displaying them). **Step 5.** Branching out (Combining the science knowledge with real life things to promote deeper understanding of the practical application of scientific knowledge in familiar daily life environments).

For the instructional intervention, the teacher simply increased the proportion of drawings included in the above teaching steps. Also, when she assigned tasks to students, she emphasized that they could use drawings in completing those tasks.

We interviewed the students and the teacher to gauge any changes in their views on the use of drawings in the science classroom after the intervention. The data we collected included questionnaires and interview transcripts, the teaching materials, and class tasks and assignments completed by the students. In analyzing the students' drawings, we used the categories from Areljung et al.'s [4] and Westlund's [7] studies, adhering as much as possible to the descriptions of the categories they provided.

3 Results and Discussion

3.1 Drawing use increased following the teacher's intervention

In the pre-intervention task, none of the 12 students used drawing: they only used words to describe the sounds they could hear (see left panel of Fig. 1 for a typical task response). In the first post-intervention task, all of the 12 students used drawings (see the right panel of Fig.1 for a typical response). This increase in drawing was maintained in subsequent lessons, including when the topic changed from “sound” to “air”.

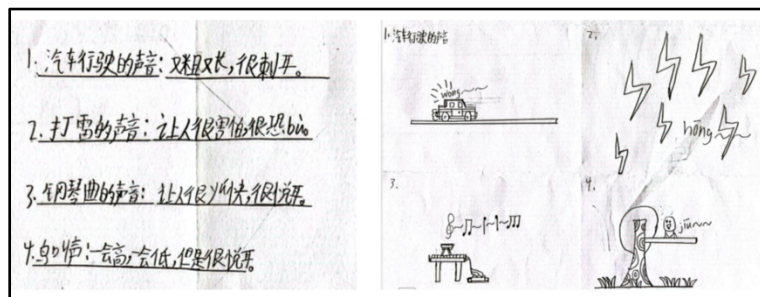


Fig.1. Task response about sounds we hear in daily life, before and after intervention.

The students used drawings (on their own or in combination with words) to express their understanding of the science content, summarize what they had learned, design experiments (including showing both their assumptions and outlining the process), and communicate with their peers. Fig. 2 shows an example of a student's drawing for designing an experiment to prove that air takes up space (with the teacher providing materials such as containers, water, water bottles, and small balls for the students to use).

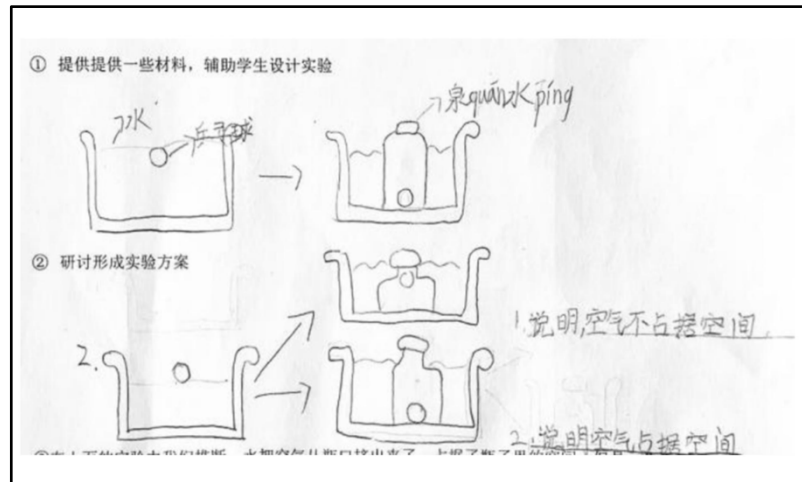


Fig. 2. One student's drawings about an experimental design.

From the interviews, according to the students, drawing was of great use in helping them understand new content and in expressing their ideas. The teacher reported apprehending better the students' actual levels of understanding of the content via the drawings they produced. Also, following the intervention, according to the teacher, many of the students' enthusiasm in class markedly increased. For example, students who were usually quiet became more actively engaged in sharing their drawings and explaining their understanding of the lesson with their classmates during group work. These reported experiences from the students and their teacher – although only anecdotal – suggest that drawings can produce desirable outcomes in Chinese primary science classes.

3.2 The examples provided by the teacher affected the students' drawings

Because the students initially had limited and varied abilities in drawing, the teacher provided example drawings for them. We observed indications that those examples might have affected the students' drawings. For example, when drawing about "sound" before receiving any examples, the students visually represented the propagation of sound in five different ways, such as straight lines, irregular curved lines, elongated irregular shapes, repeated half brackets, and waves (examples of those are shown in Fig. 3, left panel). After the teacher provided examples that used repeated half brackets and waves to show sound travel (Fig. 4), the students produced only two kinds of drawings that were the same as or similar to the teacher's examples (examples of those are shown in Fig. 3, right panel). This change suggests that the students likely imitated the

teacher's examples resulting in less variation in their drawings. In hindsight, it might have been better if the teacher had more clearly emphasized beforehand that the examples were not the only ways to draw.

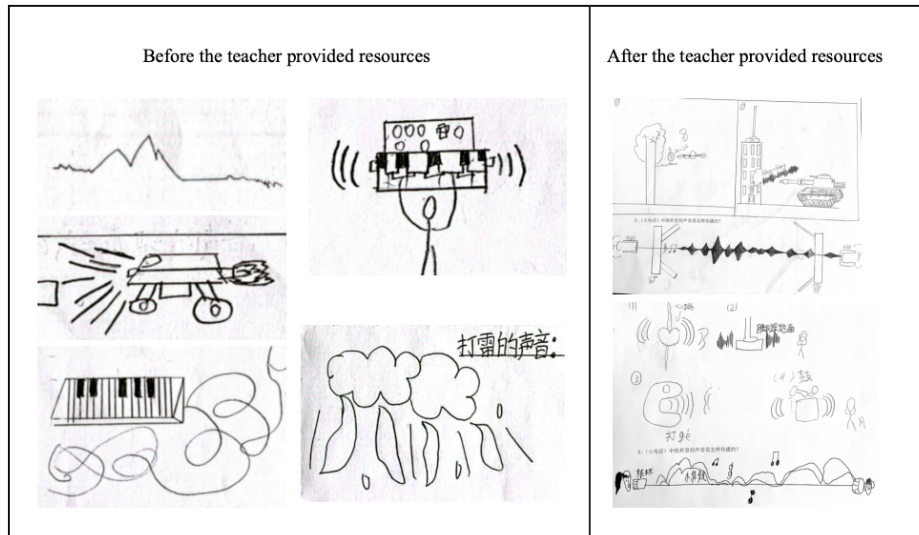


Fig. 3. Examples of students' drawings before (left panel) and after (right panel) the teacher provided the drawing examples.

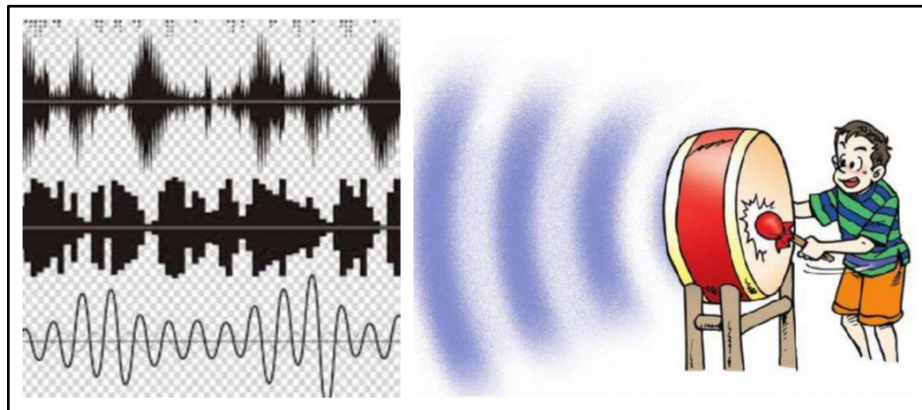


Fig. 4. The drawing examples provided by the teacher for the topic of "sound".

3.3 How the students visually represented science content

As previously noted, we used categories from Areljung et al.'s [4] and Westlund's [7] studies to examine the students' representations of the science content they were dealing with. Table 1 shows examples of the students' drawings and which of those categories they corresponded to. We also coded the representations in the 70 drawings that the students produced in the lessons about "sound" using those categories (note that

each drawing could contain one or more categories of representations in it). We found that the largest proportion of the representations were in the “Event” category, followed by “Context” and “Person”: all 12 students produced drawing representations that belonged to these three categories (see Table 2). Because the topic of “sound” includes movement and processes, the largest proportion being in the “Event” category is probably not surprising. We also found that the students tended to create contexts to show their understanding of science concepts: in other words, they tend to portray contexts that include some ‘stories’ to make sense of the ‘science’ they were learning (e.g., the two people under an umbrella during a thunderstorm in Table 1 below). However, none of the students drew anything that was categorizable as “Art”. This was probably not because students lacked imagination or creativity. We guessed that one possible reason was that the students were not provided with colored pencils, because the teacher considered that coloring the drawings would take up too much time. A second possible reason was that the content of their drawings was related to the science topic being taught and they tried to draw something more directly related to that content: as a consequence, the students probably did not even consider drawing more creative, but unnecessarily elaborate shapes.

Table 1. Examples of students’ drawings content and how they were categorized.

Drawing	Category	Explanation
 The sound of thunder	Theory	Three simple symbols to represent lightning.
	Event	Four straight lines below the thunder symbol represent the sound travel.
 The sound of thunder	Context	The student gave us a setting: In thunder storm, two people hide under a big umbrella.
	Event	Brackets represent the sound travelling.
	Person	There are two people.
	Attitude evoking	The two people cover their ears, showing a feeling of fear.

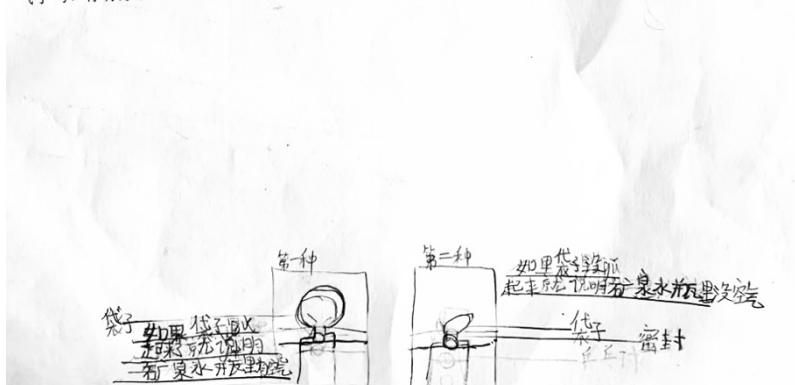
Table 2. Frequency of use of each of the representation categories in the students' drawings.

Category	No. of representations	Percentage of total	No. of students who used this representation category
Event	40	27.59%	12
Context	38	26.21%	12
Person	28	19.31%	12
Theory	19	13.10%	4
Culture	10	6.90%	10
Attitude evoking	10	6.90%	6
Art	0	0%	0

3.4 Additional findings about what some of the students found difficult

The responses the students wrote on the questionnaire administered to them suggested that they also experienced some problems in drawing. Many students stated that sometimes they felt it difficult to draw some specific things (especially those that were abstract or that they had never seen before). Therefore, they hoped the teacher could show them how to draw things like sound, air, and so on. Also, many of the students struggled with positioning their drawing on paper. Fig. 5 shows an example in which the student drew at the bottom edge of the paper and left a lot of blank space in the top half of the paper.

③在上面的实验中我们推断，水把空气从瓶口挤出来了，占据了瓶子里的空间。但是，你看到跑出来的空气了吗？你有办法让我们看到这些空气？

**Fig. 5.** Example of a poorly positioned drawing created by one of the students.

Due to differences in students' abilities to draw, it took longer for some students to draw and the teacher had to wait until all the students had finished. As a result, the teacher did not accomplish all her teaching objectives in some of the earlier lessons.

However, as the students became more proficient in drawing, the teacher reported to the first author that she could achieve all her teaching objectives in later class lessons.

4 Conclusion

In this study, we found that although drawing is at present rarely used in science classes in China, students are actually willing to draw. From our observations and the class teacher's comments, drawing appeared to help students understand scientific concepts better, express their ideas more clearly, and communicate more effectively – which are all helpful in promoting deeper learning. There were also indications that drawings raised their enthusiasm for learning. In terms of the representations shown in their drawings, the seven categories we used for coding were not equally depicted: three categories (Event, Context, Person) were used the most and by all the students, but one category (Art) was not used at all. These distributions are different from those reported by Areljung et al. [4]: the reasons for such differences warrant further examination.

We also identified some problems with applying drawings in class. Those comprised challenges for both the teacher and the students. To promote the application of drawing in Chinese science classes, the school can build a research group to integrate drawing into the curriculum and put it into the teachers' instruction manual. Furthermore, the group can develop training courses for teachers, which can include how to realistically apply drawing to the teaching process and how to assist students in drawing. Providing some training for the students' drawing would also likely be helpful.

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