Perspectives of Resources on Mathematics in Real World Contexts:
Focusing on Mathematics Textbook *"Kazu-no-Hon"* published in 1941

Hanako Senuma

Abstract:

The purpose of this paper is to clarify the characteristics of *Kazu-no-Hon*, a national textbook of mathematics for the first and second grades of elementary school published in 1941, from the viewpoint of mathematics materials connected to the real world. For this purpose, the following three points are discussed. (1) Mathematics connected to the real world, (2) the position of *"Kazu-no-Hon,"* and (3) the *"Kazu-no-Hon"* teaching materials for children and teachers (Ministry of Education, Culture, Sports, Science and Technology) and The *"Kazu-no-Hon Toriatsukaijo-no-Chui* (Precautions for the Use of the Book of Numbers)*"* (Government-General of Taiwan) from the perspective of the real world.

Point (1) describes the author's awareness of the issues related to (2) and (3)) based on his research and experience as to why he focuses on the real world. (2) and (3) are newly analyzed, and the main findings are as follows. (2) *"Kazu-no-Hon"* was the first textbook to be published when the name was changed from *"San-Jyutsu"* to *"San-Su"* (both are arithmetic in English). It inherited the mathematical ideas of "Normal Elementary School Mathematics" and included a new attempt to treat figures intuitively and dynamically. (3) The *"Kazu-no-Hon for Teachers"* contains a "Objects Classification Table" that links mathematics materials to real-world objects. Compared to the "Objects Classification Table" in "For Teachers of Elementary School Arithmetic," "weather," "people," and "things" are subdivided into "works" and included. It is suggested that mathematical activities be incorporated, such as devising ways to present mathematics problems and creating works of art. Maeda, the author of *"Kazu-no-Hon,"* says that even though the teaching materials of the time have disappeared, Japanese people still have a wealth of graphic materials in their daily lives, such as origami games, knotting strings, and mizuhiki. The "Precautions" section of the book includes precautions tailored to the realities of Taiwan (buckets of water for bathing are used to improve skin diseases, and making pegs is used for cleanliness and piety), as well as detailed explanations of the mathematical background, such as the golden ratio, suggesting how mathematics materials are connected to the real world in different countries.

Keywords: mathematics connected to the real world, Kazu-no-Hon, Objects Classification Table, Mathemaics in Japan and Taiwan

1. Introduction

Postwar mathematics education in Japan tended to focus on mathematics itself, partly as a reaction to the unit studies of the 1945s. However, in recent years, due in part to the results of the PISA survey, the ability to use mathematics has begun to be questioned in Japan. For students to develop the ability to use

mathematics, it is necessary for mathematics teachers to be able to think broadly and deeply about the relationship between the real world and mathematics. For this reason, we believe that such efforts are important in teacher training programs.

The purpose of this paper is to clarify the characteristics of *"Kazu-no-Hon,"* a national textbook of mathematics for first and second graders of elementary schools published in 1941, from the viewpoint of mathematics teaching materials connected to the real world. For this purpose, the following three points are discussed. (1) Mathematics connected to the real world, (2) the position of *"Kazu-no-Hon",* and (3) *"Kazu-no-Hon"* teaching materials for children and teachers (Ministry of Education, Culture, Sports, Science and Technology), and *"Kazu-no-Hon Toriatsukaijo-no-Chui* (Precautions for the Use of the Book of Numbers)*"* (Government-General of Taiwan) from the perspective of the real world. There are three main reasons why the author focused on the national textbook *"Kazu-no-Hon"* in 1941.

The author has conducted an analysis of real-world contexts for secondary education in the same period, namely, mathematics in high school for girls in 1943 during the movement to reconstruct mathematics education (Senuma and Kagami, 2019), which provides a consistent view of this period.

The author participated in an interview with Takakazu Maeda, who was involved in the creation of the national textbook *"Kazu-no-Hon"* as a book supervisor of the Ministry of Education (January 21, 1988). The interview was planned mainly by Eizo Nagasaki (National Institute for Educational Policy Research), with the participation of Tadao Ishida (Hiroshima University), Toru Tomitake (Yokohama National University), Shigeo Yoshikawa (Joetsu University of Education), Hanako Senuma (National Institute of Education), and Hiroyuki Iwata (Osaka Shoseki) (Sawada [principal investigator], 1989). (All affiliations were at the time)).

We were given PDF files of mathematics textbooks and other materials in the "Modern Textbook-related Materials," a valuable collection owned by the Tamagawa University Museum of Education and registered as a Tangible Cultural Property. The *"Kazu-no-Hon Toriatsukaijo-no-Chui* (Precautions for the Use of the Book of Numbers)*"* (Government-General of Taiwan, 1942) discussed in this paper is one of the books in the list of mathematics textbooks (55 books published by the Government-General of Taiwan, 333 books published by the Korean Governor-General's Office, and 9 books by the Manchurian Imperial Government's Civil Affairs Department, etc.) in the "Catalog of Foreign Textbooks in the Tamagawa University Museum of Education" (Tamagawa University Museum of Education, 2007).

2. Mathematics Connected to the Real World

2.1 Real-world mathematics in research studies and curriculum guidelines

2.1.1 Challenges in creating mathematics linked to the real world in international academic achievement surveys

In my previous position at the National Institute for Educational Policy Research, I was involved for many years in research on international surveys on academic achievement, such as the Trends in

International Mathematics and Science Study (TIMSS) of the IEA and the Programme for International Student Assessment (PISA) of the OECD. Compared to other countries, many Japanese students did not view mathematics as a developmental subject and thought that it was not relevant to their daily lives.

When creating and translating survey questions, it is easy to translate abstract mathematics questions, such as equations and figures, but when the questions involve real-world situations, it is sometimes difficult to translate them without changing the purpose of the questions. For example, in the TIMSS survey on calculating decimals, we set the scene of shopping in dollars in the U.S. because expressing money in decimals is unfamiliar in Japan. The PISA survey defines mathematical literacy as "the extent to which 15-year-olds have acquired the ideas, knowledge, and skills that they will need in their lives in the future," and defines the situations in which mathematics is used for private, educational, professional, public, and scientific purposes; however, this was a difficult task for Japan, where people tend to learn abstract mathematics.

2.1.2 Japanese Junior High School Mathematics Classes with Little Real-World Content

In the TIMSS 1999 video study of mathematics classes, which was conducted as an ancillary study to the IEA's TIMSS survey, second-grade junior high school mathematics classes were filmed for comparison and analysis in seven countries: Australia, the Czech Republic, Hong Kong, Japan, the Netherlands, Switzerland, and the United States. The video for Japan was shot in 1995, and the video for other countries was shot in 1999 (100 lessons in principle, but 50 for Japan). The author participated in this study as (National Research Director (NRC). As a result, various characteristics of mathematics classes in Japan were identified. The percentage of mathematical problems related to the real world (white area in Figure 1) was 9% in Japan, the lowest among the seven countries.

2.1.3 Japanese textbooks with little real-world content

The National Institute for Educational Policy Research and Japan Textbook Research Center jointly conducted an international comparative study of science and mathematics textbooks (National Institute for Educational Policy Research, 2009). The author was responsible for analyzing American mathematics textbooks. The author was in charge of the analysis of American math and arithmetic textbooks because she had spent time in the United States as an overseas researcher and was familiar with the background of mathematics education in the United States and changes in the curriculum. When I analyzed an American textbook, I was surprised by various perspectives that differed from those of the Japanese textbooks. The situation is different in the U.S. than in Japan because the U.S. does not have a textbook certification system. On the one hand, when I looked at advanced American mathematics textbooks, they were rich in real-world contexts and had plenty of proper nouns, such as the names of places and people in the index at the end of the book. On the other hand, Japanese mathematics textbooks had little real-world content, and the indices at the end of the books were limited to mathematics content.

2.1.4 Emphasis on the cycle between the real world and the mathematical world in the latest curriculum

guidelines

However, in recent years, due in part to the results of the PISA survey, the ability to use mathematics has been questioned in Japan. This is particularly true for the latest curriculum guidelines.

This is due to the fact that the Central Council for Education Report (2016) presents a diagram of the learning process for mathematics. Therefore, the same diagram has been incorporated in the Commentary on the Curriculum Guideline (Ministry of Education, Culture, Sports, Science, and Technology, 2017, p. 8).

The process of finding and solving problems in mathematics is characterized by an emphasis on the cycle between the real and mathematical worlds. This is the process of mathematically transforming events in daily life and society and the process of returning the results (so-called solutions) obtained in the mathematical world to the real world to consider their meaning.

The emphasis on the cycle between the real world and the mathematical world has been advocated in mathematics education, such as the "mathematical literacy framework" of the PISA survey and the "open-ended approach."

2.2 Approaches for college students in the teaching program

2.2.1 Connecting mathematics to the real world through problem-building activities

An important skill for mathematics teachers is the ability to create problems. However, students in teacher training programs have experience in solving mathematics problems, but little experience in creating them. Many students think that teaching mathematics means giving them knowledge and skills, and teaching them how to solve problems. Therefore, as a part of problem creation, I have been using "mathematics calendars" to teach my seminar students and others.

This is a way of making problems wherein the date is the answer to the problem. One student created a calendar problem for November 2: "What is the on the backside of the number five on the dice? (answer: 2). This question was based on the rule that the dice is made so that the sum of the numbers facing each other is seven. Some students made a question about "the number of legs of a crane" (answer: 2). One student made a subtraction problem for November 8: "51-43=?" (The answer is 8), and one student wrote, 'How much is the 8% consumption tax on a 100-yen onigiri (takeaway) at a convenience store?' (The answer is 8). The latter was a problem that connected real-world knowledge of the difference in consumption tax between takeout and eating on the spot (8% for the former and 10% for the latter) with arithmetic. In this way, we hope that students will learn to think about numbers such as 1, 2, 3, etc. in the abstract world of numbers and at the same time "make problems" by connecting them to the real world.

2.2.2 Connecting mathematics to the real world through the wonder and fun of mathematics

Many students are surprised when they discover that their birthdays or the number they think of can be guessed. Mathematics is connected to the real world in several ways. Even things that seem strange at first glance have a mathematical basis when the reasons for them are considered. There is an abundance of

magic in number estimation, such as the magic of the binary system in the background, the magic of utilizing letter formulas to clarify the reason, and the magic of utilizing $111 = 37 \times 3$.

Therefore, in the 2019–2021 school year, I designated the “Dictionary of Mathematical Magic” (Ueno, Fumio, 2019) as the textbook for the “Reading of Famous Books” class, aiming to enable students to interpret and perform magic in their own way. This textbook also contains a magic trick that uses the radio section of a newspaper and the fact that the frequency of AM radio stations is a multiple of nine. In 2021, the students were required to present their work in a PowerPoint presentation or demonstrate it in a zoom. There were many excellent presentations that connected to the real world, discussed things more mathematically and developmentally, and the students' motivation and communication skills improved.

2.2.3 Connecting mathematics to the real world through comparison of textbooks as teaching material research

Students have been learning from one type of mathematics textbook. However, six textbooks for elementary schools and seven textbooks for junior high schools have been certified and published. In my classes on “Elementary School Mathematics” and “Methods of Teaching Elementary School Mathematics,” I conducted research on teaching materials by comparing textbooks. The reason for this is that, even though the general framework of the textbooks is the same because they have undergone certification, each textbook has its own unique way of using real-world situations as teaching materials.

For example, comparing the introductory problem of “congruent figures” in the 2020 mathematics textbooks, we can see that the congruent figures are either objects that are known to overlap perfectly, such as playing cards, hangers, DVDs, stamps, etc., or scenes in which the students find the parts that fit the stained glass, or a story in which they drop a puzzle. There are many ways to introduce this, such as using a story about a student who has dropped a puzzle, cutting out a piece of paper from the back of a book and overlapping it on a sailboat flag to find the shape that overlaps perfectly, or finding the shape that overlaps perfectly in a rectangle made up of four points on a circle.

Students often do not think deeply about the reasons for this introduction, but just teach it because it is present in the textbook. It is necessary to consider the value of each teaching material while connecting mathematics to the real world through a comparison of textbooks as teaching material research.

2.2.4 Connecting mathematics to the real world through changes in the curriculum guidelines for mathematics studies

The current Courses of Study provide goals, content, terminology, and symbols, but do not describe experiences (life experiences). They did so when the Courses of Study were drafted (1948 and 1951 editions). Table 1 is a quotation from the "List of contents of instruction in mathematics" (1948 edition) (https://erid.nier.go.jp/files/COFS/s23em/index.htm) in the “List of Courses of Study” in the Educational Research Information Database of the National Institute for Educational Policy Research. The left side of Table 1 shows examples of experiences when counting specific numbers of 35 or less in the first grade, such as “the number of shells, the number of flowers, the number of children, the number of books, the

number of fruits, the number of cars, the number of paddles, the number of balls, and the number of swings.” In the seventh grade on the right side of Table 1, examples of life experiences are given for numbers of one trillion and larger: “In relation to population and budgets, and in view of food shortages...find out what food is needed and find out the cost of importing food from abroad.” However, beginning with the 1958 edition, experience was no longer mentioned. If the contents of mathematics are not related to the real world, it is natural for students to think that mathematics are “abstract’ and “useless for daily life.” Therefore, when explaining the Courses of Study, we make sure to explain not only the latest Courses of Study but also those from the 1945s.

This is the background of mathematics in relation to real-life. In the following sections, I will examine the real world of the national textbook *“Kazu-no-Hon.”* First, I will explain the position of the *"Kazu-no-Hon".*

Positioning of “Kazu-no-Hon”

3.1 *“Kazu-no-Hon”* is one of the three national arithmetic textbooks from the Meiji period to the early Showa period

The “Normal Elementary School Mathematics” (commonly known as “Green Cover”), published in 1935, is a textbook that has been historically acclaimed. The “Normal Elementary School Mathematics” (commonly known as “Black Cover”), published after 1905, has not been well received in the history of mathematics education. Although *“Kazu-no-Hon”* and “Elementary School Mathematics” (commonly known as “light blue covers”), which followed the green covers, were important as an opportunity to change the name of the subject to “Elementary School Mathematics” after the war, their contents are often discussed in relation to the wartime period because of the background of national schools during the war.

Takagi described how green-covered textbooks, especially those for the first grade, were welcomed. The book was well received not only by the arithmetic education community but also by families with children and the general public. Although the price may have been lower than other picture books, mothers of kindergarten children competed with each other to buy this textbook and give it to their children, making it extremely popular as a “mathematic book” that children would enjoy (Takagi, 1980, p. 389).

However, after only a year or so, the textbook began to be criticized in schools for being difficult to read and understand, and the teacher's manual was cumbersome.

3.2 Teacher's books not including reduced versions of textbooks for children and students

The aforementioned complication of the teacher's manuals is an issue that is still prevalent today. The teacher's book for black-covered textbooks had a reduced version of the pupil's book inside the teacher's book, with simple notes on instruction and answers or supplementary questions added to the outside. However, in response to the request of the 33rd National Council of Teachers of Arithmetic in 1929 that “the arithmetic book for teachers should omit the problems for children that were in the black cover, and

should contain detailed information on the purpose of the compilation, reference matters for teaching, and notes on the use of the book," the instructional books with green and light blue covers were printed with a reduced version of the textbook for children and students in the center, with explanations and answers in the surrounding areas. The format of writing explanations and answers around the textbook was eliminated. However, since elementary school teachers are mainly in charge of all subjects and not all of them are proficient in arithmetic, the tiger-book style of instructional day plan formulas was rampant, and many of them relied on explanations of day plan formulas in educational magazines instead of detailed teacher's manuals. The problem of how teachers' manuals should be is an issue that is still relevant today, more than 70 years later. Even today, there are still many teachers who tend to rely on instruction manuals published by textbook companies and the instructional plans in educational magazines, rather than reading the Commentary on the Courses of Study and thinking for themselves.

3.3 "Kazu-no-Hon 4" is a textbook for second graders

In 1941, when elementary schools became national schools, the subjects were reorganized, and the four subjects of national school elementary (now elementary school grades 1–6) were national studies, science and mathematics, physical training, and the performing arts. As compulsory education became eight years old, the National School also offered higher education (the first and second years of junior high school). The science and mathematics department consisted of arithmetic and science. "Kazu-no-Hon" is a textbook for the first and second years of arithmetic at the National School of Science and Mathematics, and "Elementary Arithmetic" for the third, fourth, fifth, and sixth years, all of which were published in two volumes per grade: one for students and one for teachers. Because two books are published for each grade, "Kazu-no-Hon 4" is a textbook for the second semester of the second year, and "Elementary Arithmetic 8" is a textbook for the second semester of the sixth year. Since "Elementary Arithmetic" is a textbook for elementary school, it is labeled "Elementary." The textbook for higher education is "Higher Education Arithmetic."

As for science, there is no textbook for children in the first, second, and third grades; only the teacher's textbook "Observation of Nature." Two copies of "Observation of Nature" were published for each grade, and one copy of "Elementary Science" was published for each grade.

3.4 Ryuichi Maeda created "Kazu-no-Hon" as a book supervisor for the Ministry of Education.

Textbooks reflect the author's philosophy, ingenuity in mathematics, and their education. This is the same today as it was in the past. For this reason, it is important to clarify who the authors were and the principles on which the textbooks were based in order to understand their contents.

"Kazu-no-Hon" and "Elementary Arithmetic" (light blue cover) were edited by Ryuichi Maeda (Library Supervisor at the Ministry of Education), Norio Mori (assistant supervisor of the library at the Ministry of Education), Juro Ando (former professor at Tokyo Higher Normal School), and Yoshio Ikematsu (Tokyo Metropolitan Government inspector). However, Maeda was transferred to the upper secondary school section after editing "Kazu-no-hon" was completed, and Toshiro Maruyama (supervisor of books, Ministry

of Education) took over. It is said that “higher education arithmetic” was written by Yoshinobu Wada. Postwar-inked textbooks (1945) and provisional textbooks (1946) were based on this textbook (Nagasaki, 1997, p. 33).

3.5 “Kazu-no-Hon” is characterized by its relationship to science and the development of graphic content

“Kazu-no-Hon” basically inherited the editorial policy of “Normal Elementary School Arithmetic,” but it was characterized by its consideration of the relationship with science and the development of graphic content. The consideration of the relationship with science is for the purpose of the national school science and mathematics. Regarding the development of the figures, Maeda stated the following: “We had no time to prepare, so we consulted with Mr. Shiono and decided to take over the editing of the Green Book, while taking into consideration the relationship with science. However, Mr. Shiono specifically requested that we develop the content of the figures section, as he felt that the content of the green cover was still lacking (Maeda, 1995, pp. 4–5).”

However, Maeda felt that there was a difference in philosophy between him and his predecessor and stated that this was because “Shiono sees mathematics through the eyes of a physicist, and I see it through the eyes of a mathematician (Maeda, 1995, p. 5).”

In order to see the characteristics of “Kazu-no-Hon,” I examined previous studies, as shown in Table 2. Makinae (2012) stated that “Kazu-no-Hon” reflects a “dynamic view of figures” and has innovative teaching materials (such as “Kazu-no-Hon 2” and “various forms of shadows”) that have never been used before.

As far as I could find in CiNii, there are no previous studies that use “object classification table” and "Kazu-no-Hon, Taiwan" as search terms, which will be discussed in Chapter 4.

3.6 “Normal Elementary Arithmetic,” “Kazu-no-Hon,” and “Elementary Arithmetic” Used in Taiwan with a Different Climate

This section discusses the use of arithmetic textbooks in Taiwan. Jochi (2003) categorized the period of elementary mathematics education in Taiwan into three periods: the National Language Teaching Period (1895–1908), the Governor's Office Teaching Materials Period (1909–1934), and the Ministry of Education Teaching Materials Period (1935–1945). In public schools, teaching materials edited by the Taiwan Governor's Office were used until 1934, but from 1935 onwards, textbooks from the interior (Japan) were used directly. Table 3 shows the position of “Kazu-no-Hon Toriatsukaijo-no-Chui (Precautions for the Use of the Book of Numbers)Handling’ (Government-General of Taiwan, 1942) in the context of the period classification of Taiwan, as indicated by Jochi.

The author has been involved in international academic achievement surveys, as described in “2.1.1 International Academic Achievement Surveys.” The mathematics questions for the assessment were prepared by participating countries. The question sets were prepared in English, and each country translated them into their own language. The names of women were translated into the names of women in their countries. At a meeting with the international committee members of PISA Mathematical Literacy, it

was discussed whether it was acceptable to ask a mathematical literacy question whose context required snow in a country where it never snows. Because of these various experiences in translation, I became interested in the precautions to be taken when dealing with textbooks from other countries.

4. “Kazu-no-Hon” Teaching Materials for Children, Teachers, and Handling Precautions from a Real-World Perspective

4.1 The Real World as Seen in the “Objects Classification Table” in the Teacher's Appendix

In the appendix of “Kazu-no-Hon for Teachers,” there are three tables: “Objects Classification Table,” “Classification Table of Main Teaching Materials,” and “Class Time Distribution Table,” while in “Elementary Arithmetic for Teachers,” there are three tables: “Classification Table of Main Teaching Materials,” “Class Time Distribution Table,” and “Classification Table of Terms and Symbols.” “The Classification Tables of Things” was published in “Normal Elementary School Arithmetic” only in the first year.

In “One Hundred Years' History of the Japanese Society for Mathematics Education” (ed. by the Japanese Society for Mathematics Education, 2021), it is shown that “Normal Elementary Arithmetic” was introduced in “Journal of the Japanese Association for Secondary Mathematics Education” (the predecessor of the Japanese Society for Mathematics Education) six times in total from 1935 to 1940. Looking at the original article (Nabeshima, 1935), the “Objects Classification Table,” “Table of Classification Table of Main Teaching Materials,” and “Classification Table of Terms and Symbols” of “Normal Elementary Arithmetic” are listed as book introductions. However, there is no mention of the “Objects Classification Table” of “Kazu-no-Hon” and “Elementary Arithmetic” in this Centennial History. It is unclear why the “Objects Classification Table” is not found in “Normal Elementary School Arithmetic” (black cover) from the Meiji period onward but is found in “Normal Elementary School Arithmetic” (green cover) and “Kazu-no-hon" (light blue cover).” The “object classification table” seems to be important in examining mathematics connected with the real world and is therefore the subject of this paper.

4.2 The seven frameworks of the object classification table are “scene,” “weather,” “imagination,” “children's life,” “object,” “person,” and “figure.”

The first two books, “the first volume of Normal Elementary Arithmetic, First Grade, for Children” and “Kazu-no-Hon 1” are both the first books for the first grade, and “For Children” is a beautifully colored national textbook published by the Ministry of Education. “The first volume of Normal Elementary School Arithmetic, First Grade, for Children” is a textbook with only pictorial illustrations, and “Kazu-no-Hon 1” also has almost no text and proceeds with pictorial illustrations.

Table 4 shows the “Objects Classification Table” in the appendixes of the first volume of “Arithmetic for Children, First Grade, Teacher's Edition” and “Kazu-no-Hon 1, Teacher's Edition,” with the common “objects” in the same framework shaded in bold. Since the first volume of “Normal Elementary School

Arithmetic: First Grade Teacher's Edition" is not held by Senuma and is not digitally available at the National Institute for Educational Policy Research or the National Diet Library, it was prepared with reference to the book introduction by Nabeshima (1935).

As Maeda mentioned in the above Section 3.5 that he had inherited the editing of the Green Book, I expected that the “Objects Classification Table” would have many things in common. However, as shown in Table 4, the framework was largely inherited, but the details of real-world examples were different. The “object classification table” is organized into five major frameworks: “scene,” ‘imagination,” “children's life,” “object,” and “figure.” However, looking at the framework of “objects,” “Kazu-no-Hon” newly included “works,” which was not included in “Normal Elementary School Arithmetic,” which is a characteristic of the framework. The total number of objects is 84 in “Vulgar Elementary Arithmetic” and 83 in “Kazu-no-Hon,” which are approximately the same. In order of the number of things in “Normal Elementary School Arithmetic,” there are 19 “things and animals” and 14 “things and others.” In “Kazu-no-Hon,” there are 12 “things” and “animals,” 9 “children's life” and “outdoors,” 8 “things” and “school supplies,” and 8 “things” and “others.” The shaded areas in bold, or 26 items, or approximately 30% of the total, are common. There are no common objects in “scenes” and “things” and “food.” Since “Kazu-no-Hon” was deleted and created as the base textbook for the postwar Sumi-Nuri textbook (1945) and the provisional textbook (1946), it is easy to emphasize its relation to the war, but Table 4 shows that “Normal Elementary Arithmetic” also contained teaching materials during the war. Table 4 is for the first half of the so-called first year, so the framework of the object classification table is five: “Scene,” “Imagination,” “Children's Life,” “Objects,” and “Figures,” but in the second half of the first year, “Weather” and “People” were newly added to “Kazu-no-Hon,” bringing the framework to seven.

4.3 Name of “Person” in “Objects Classification Table”

Table 4 shows the details of “weather,” “people,” and “objects” and “works” in Kazu-no-Hon 2, Kazu-no-Hon 3, and Kazu-no-Hon 4 (Ministry of Education, 1941f, 1941 g, and 1941h), which were not included in the first volume of “Normal Elementary School Arithmetic: First Grade Teachers' Edition. In Table 4, “weather” (e.g., evening showers, rainbows), “people” (e.g., Hanako), and “objects” are subdivided into “works” (e.g., shide, paper rings; the so-called Mobius circle). In Table 5, the items discussed in Sections 4.4 and 4.5 are shown in bold shading.

In the textbooks for the 2020 and 2021 school years, in line with the new Courses of Study's appeal point of “independent, interactive, and deep learning,” two to six male and female main characters in each textbook discuss ideas for learning mathematics and arithmetic and promote independent and interactive learning (Senuma, 2021). As for the main characters, they have modern names that differ from those in Table 5.

4.4 Arithmetic materials for “weather” and “people” in the “Objects Classification Table”

Figure 4 shows the teaching materials of “Evening shower” and “Rainbow” from “Weather” and “Hanako” from “People”. Both are from “Kazu-no-Hon 3,” and the original text is in color. The “Evening

Showers" and "Rainbows" teaching materials are: "The evening showers have stopped. My brother and I went to the field to pick cucumbers. We took 53 cucumbers. I took only 20 cucumbers. How many cucumbers did my brother pick?" (Ministry of Education, 1941c, p. 32).

The example of the teaching material for "Hanako and Harue" is: "Hanako-san and Harue-san were showing each other the shells they had picked up at the sea during their summer vacation. Hanako-san had 56 shells. Hanako-san had 56 shells, and Harue-san had only 21." (Ministry of Education, 1941c, p. 38) Regarding this question, the teacher's manual (Ministry of Education, 1941 g, pp. 50–51) suggests that in addition to connecting the seashells to the child's experience that children who go to the beach in summer always pick up seashells, it is also good to relate the seashells to those in the Japanese language textbook of the time, "Yomikata 3." In addition, it is meaningful to bring and handle seashells in order to develop the teaching of the section "Collecting shapes" (to let children find interesting shapes in natural objects and phenomena and to enrich their direct perception, which is the basis of their spatial awareness). Thus, it is important to connect arithmetic with the real world in terms of children's experience, connection with other subjects, and connection between number and shape problems.

The illustrations in "Kazu-no-Hon" are by Keiji Imazeki, a Shunyokai member commissioned by Maeda, and are different from those in other subjects and in "Elementary Arithmetic." (Maeda, 1989, p. 9)

4.5 Arithmetic materials for "objects" and "works" in the "object classification table"

Figure 5 shows the teaching materials for "Mobius circle" and "Shide" from "Works" as a subdivision of "things." The original text is shown in color. Since both the Ring of Möbius and Shide are graphic materials, I will first describe the basic policy of the composition of graphic materials. There are two main intentions (Maeda, 1989, p. 10–11) for the graphic materials: 1) to develop analytical consideration as necessary based on direct perception, and not to systematize which comes first, spatial or planar; 2) we do not consider figures as fixed, but as dynamic. In the first and second years, students are given a wealth of experiences that will lead to the development of various graphic materials in the future. Klein's non-Euclidean geometry is the background to this.

The Möbius wheel is teaching material in Kazu-no-Hon 4 and is listed in the classification table as a "paper ring." It is the fifth problem of "February's miscellaneous problems." The main activity is to let the children investigate on their own without going into terminology and reasons. How many pieces of paper did you cut into 3 cm wide pieces? How many pieces did he cut? Once he twisted the paper into a circle, it took on an interesting shape. I placed the scissors in the middle of the circle and cut it. What shape will this take? (Ministry of Education, 1941d, p. 37) Since the Möbius circle is related to the topological view of shapes, I thought it was a teaching material from the era of the modernization of mathematics education in the 1960s, but I was surprised to find that it was covered in a second-grade elementary school math textbook about 80 years ago. In 2020, a textbook featured it on a special page for sixth graders.

"Shide" was devoted to the topic in Kazu-no-Hon 2. Let's make a shide out of a half piece of paper. (1) Cut it into two pieces. (2) Fold into four. (3) Fold it into three pieces. (4) Insert the scissors. (5) Make another identical one. (6) Fold them back in order. (Ministry of Education, 1941b, pp. 21–22)

As for the value of teaching materials, Maeda, the author of Kazu-no-Hon, relates it to Japanese life as follows: “The folding process creates spatial symmetry. It is rich in content as a teaching material, as it can be folded in two spatially symmetrical ways...this material was excluded and disappeared in the postwar atmosphere. However, in the lives of the Japanese, there are still rich graphic materials such as origami, string and mizuhiki tying, and others” (Maeda, 1989, p. 14).

On the other hand, in “A Cautionary Tale for Handling” (Government-General of Taiwan, 1942, p. 20), it is explained that if the shide cutting method is to be practiced at home, special guidance should be given to maintain cleanliness and a pious attitude. It is suggested that through mathematics, not only attitudes toward mathematics but also general attitudes should be cultivated.

4.6 Comparison of “Ohajiki” and “Paper and Crayon” in “Kazu-no-Hon,” “Normal Elementary School Arithmetic,” and “Kazu-no-Hon Toriatsukaijo-no-Chui (Precautions for the Use of the Book of Numbers)”

In the introduction to Kazu-no-Hon, the Taiwan Governor's Office lists six points of caution, such as substituting appropriate materials if they do not match the seasons in Taiwan and converting teaching materials in consideration of special circumstances, such as social conditions and customs. Indeed, looking at the commentaries for each grade, there are sections based on these points of view. Therefore, I compare “Kazu-no-Hon,” “Normal Elementary Arithmetic,” and “Kazu-no-Hon Toriatsukaijo-no-Chui (Precautions for the Use of the Book of Numbers)” in the first semester of the first year. “Kazu-no-Hon 1” is a revolutionary textbook that uses only pictures and almost no text. There has never been a textbook such as this in the history of mathematics education before or since. In “Kazu-no-Hon 1” (Ministry of Education, 1941a, pp. 3–4), “Paper and Crayon” and “Ohajiki” are similar to those in the first volume of “Normal Elementary Arithmetic 1” (Ministry of Education, 1935, pp. 4–6), although the Japanese flag is drawn on the blackboard and the arrangement of the Ohajiki is slightly different.

In “Kazu-no-Hon Toriatsukaijo-no-Chui (Precautions for the Use of the Book of Numbers)” (Taiwan Governor's Office, 1942, pp. 6–7), in addition to those related to the culture and climate of Japan and Taiwan and the order of instruction (e.g., the order of “paper and crayon” and “Ohajiki” should be changed, it is better to handle them after the Emperor's Birthday, and the colors should be limited to those necessary for drawing the Japanese flag), the following information is given: In addition, the number of buttons and the shapes they make will lead to the discovery of interesting shapes, such as the order of leaves on plants, the positions of tennis and baseball players, and the shapes of stars in the sky. The book shows how to view arithmetic materials that are connected to the real world, such as sports and arithmetic and celestial objects and arithmetic.

4.7 Kazu-no-Hon, Distinctive Teaching Materials (Kazu-no-Hon Toriatsukaijo-no-Chui (Precautions for the Use of the Book of Numbers)) (Taiwan Governor's Office, 1942)

In addition to the aforementioned, there are other sections that provide detailed explanations of the mathematics behind the arithmetic materials, which are not mentioned in the introduction. For example, in the section on “Shapes and Quantities” (Government-General of Taiwan, 1942, pp. 12–14) in the notes on

handling “Kazu-no-Hon 1” the author explains mathematically why the Japanese flag is beautiful by relating it to the golden ratio. He also expands the value of the material from arithmetic to hygiene situations. “My brother and I are filling the bathtub with water. You are now on your 30th cup. We have 25 more cups to fill. How many cups will we fill together?” (Ministry of Education, 1941c, p. 29) is a sentence problem involving the addition of integers, but it says, “On the mainland, baths have not yet become widespread in ordinary households. It is necessary to inform the public of the need for such baths in relation to hygiene and health” (Taiwan Governor's Office, 1942, p. 26). This suggests that the connection between arithmetic and mathematical materials and the real world should be adapted to the realities of Taiwan.

5. Summary and Future Issues

The main findings of this paper are as follows.

(1) “Kazu-no-Hon for Teachers” contains an “Objects Classification Table” that links mathematics materials to real-world things. Compared to the “Objects Classification Table” in “Normal Elementary School Arithmetic,” “weather,” “people,” and a subdivision of “things” and “works,” have been added. This suggests the need to incorporate mathematical activities, such as devising ways to present mathematics problems, and creating works of art. Maeda, the author of “Kazu-no-Hon,” says that Japanese people still have a wealth of graphic materials in their daily lives, such as origami games, knotting strings, and mizuhiki.

(2) The “Precautions for Handling” section includes precautions tailored to Taiwanese conditions (a sentence about filling a bath with a bucket of water focuses on the improvement of skin diseases, and a detailed explanation of the mathematical background, such as the golden ratio, focuses on cleanliness and pious attitudes), suggesting how mathematics materials are connected to the real world in different countries.

The main issues for the future are as follows.

-To examine the teaching materials of “Elementary Arithmetic” following “Kazu-no-Hon.”

-To place the graphic materials that were characteristic of “Kazu-no-Hon” in the context of current mathematics materials.

-To examine the teaching materials of “mathematics connected with the real world” by clarifying the process of creating the “object classification table.”

Appendix

This research was supported by a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science (Project No. 18K02942).

References

Ueno, Tomio (2015), *Suugaku Majikku Jiten Kaiteiban* (*Mathematics Magic Dictionary Revised Edition*),

Tokyodo, pp. 1–216
National Institute for Educational Policy Research (NIER, 2009), "International Comparative Research Results Regarding Science and Mathematics Textbook," *Follow-ups of the Third Science and Technology Basic Plan: Investigation on the Part of Science and Mathematics Education*, NIER, pp. 1–327
NIER, "List of Course of Study," Education Research Information Database
Senuma, Hanako (2021), "School Mathematics and Gender: From the Progress of Related Studies and Practices," *Gakjutsu No Doukou* (*Academic Trend*) , vol. 26, issue 7, Japan Science Support Foundation, 99. 22–29
Senuma, Hanako., Kagami, Katsuhisa (2019), "*Jenda No Shiza Ni Yoru Sugakukyouiku –Koutou Jogakkou Suugaku Kyoukasho No Bunmyaku Wo Chuushin Ni* (*Mathematics Education from Gender Perspectives –Focusing on the Context of Mathematics Textbook Used in Pre-WWII Girls' High School–*)," Annual Convention Proceedings of the Japan Society for Science Education 43, pp. 27–28.
Jochi, Shigeru (2003), "Education of Abacus in Taiwan under the Japanese Rule; At Primary School," *Taiwan Ouyou Nichigo Kenkyu 1* (*Applied Japanese Study in Taiwan 1*) pp. 1–23
Government-General of Taiwan (1942), *Kazu-no-Hon Toriatsukaijo-no-Chui* (*Precautions for the Use of the Book of Numbers*), Yoshimura Printing (Taipei), pp. 1–31
Takagi, Sakae (1980), *Shougaku Sanjutsu no Kenkyu* (*Study of Elementary School Arithmetic*), Tokyokan Publishing Co., Ltd., pp. 1–392
Tamagawa University Museum of Education, eds. (2007), *Tamagawa Daigaku Kyouiku Hakubutsukan Shozou Gaichi Kyoukasho Mokuroku* (*Tamagawa University Museum of Education Collection Catalog of Textbook Used in Occupied Regions by Imperial Japan*), pp. 1–234
Central Council for Education (2016), "Appendix 2/3 of report number 197 of Central Council of Education, Youchien, Shougakkou, Chuugakkou, Koutougakkou oyobi Tokubetsushien Gakkou no Gakushu Shidou Youryou tou no Kaizen oyobi Hitsuyou na Housaku tou ni tsuite (Measures for Improvement and Necessary Innovations of Courses of Study Used at Elementary, Middle, High Schools, and Special Support Schools), https://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2017/01/10/1380902_3_2.pdf (Accessed on July 1, 2021)
Central Council for Education (2003), "Characteristics of Mathematics Education in Japan," (Ministry of Education, Culture, Sports, Science and Technology, MEXT), ttps://www.mext.go.jp/b_menu/shingi/chukyo/chukyo3/005/gijiroku/03070801/006.pdf (Accessed on July 1, 2021)
Nagasaki, Eizo (1997), "Sansu (Sugaku) ka no Kyoukasho no Chosakusha (Authors of Arithmetic (Mathematics) Textbooks)," Nakamura, Kikuji (primary investigator), The Research on the School Textbook System as Compilation, Issue, and Others in Japan, Japan Textbook Research Center, *Grant-in-Aid for Scientific Research (B) (1) Final Research Report*, pp. 29–44
Nabeshima, Nobutaro (1935), "Shoseki Shoukai Jinjou Shougakkou Sanjutsu Daiichigakunen Jidouyou Kyoushiyou Jou (Review of Arithmetic Textbook of First-Grade Students' Version and Teachers' Version

Used in Pre-WWII Elementary School: First Volume)," *Journal of the Mathematical Association of Japan for Secondary Education*, vol. 17 issue 3, pp. 178–181
Japan Society of Mathematical Education, eds. (2021), *Nihon Sugaku Kyouikukai Hyakunen-shi* (*The 100 Years History of Japan Society if Mathematical Educarion*), Tokyokan Publishing Co., Ltd., pp. 1–515
Maeda, Ryuichi (1995), *Sho/Chugakko wo Ikkansuru Shoto Zukeikyoiku heno Teigen* (*Proposals for Consistent Basic Geometry Education for Elementary and Middle Schools*), Tokyokan Publishing Co., Ltd., pp. 1–166
Maeda, Ryuichi (1989), "Sugaku Kyoiku no Genri wo Motometsudukete Hanseiki (Half Century in Search of Principles of Mathematics Education)," Sawada, Toshuo (principal investigator), Sansu/Sugaku Kyoiku no Kaiko to Tenbo (Retrospect and Prospects of Mathematics Education), NIER, *MEXT Grant-in-Aid for General Scientific Research (A) Research Report vol. 5*, pp. 1–31
Makinae, Naomichi (2012), "Revaluation of the Teaching Materials for Geometry in '*Kazu-no-Hon*' Through the Comparison with 'Jinjo Syogaku Sanjutsu'," *Research Jounal of Teaching and Learning Materials vol. 23*, pp. 43–50
MEXT (2017), *Commentary on Mathematics Education in Elementary School Courses of Study (2017 Edition)*, Nihon Bunkyo Shuppan Co., Ltd., pp. 1–401
Ministry of Education, Science and Culture (MESSC, 1926), *Jinjo Shogaku Sanjutsusho Daisan-gakunen Jido yo* (*Arithmetic for Elementary School Third-Year Students*), Nihon Shoseki Kabushiki Gaisha, pp. 1–97
MESSC (1935), *Jinjo Shogaku Sanjutsusho Dai-ichi-gakunen Jido yo Jo* (*Arithmetic for Elementary School First-Year Students First Volume*), Nihon Shoseki Kabushiki Gaisha, pp. 1–32
MESSC (1941a), *Kazu-no-Hon 1* (*Book of Numbers 1*), Nihon Shoseki Kabushiki Gaisha, pp. 1–32
MESSC (1941b), *Kazu-no-Hon 2* (*Book of Numbers 2*), Kyodo Printing Co., Ltd., pp. 1–51 (from National Diet Library Digital Collections)
MESSC (1941c), *Kazu-no-Hon 3* (*Book of Numbers 3*), Nihon Shoseki Kabushiki Gaisha, pp. 1–53
MESSC (1941d), *Kazu-no-Hon 4* (*Book of Numbers 4*), Toppan Inc., pp. 1–54 (from NIER Educational Library Digital Collections of Historical Significance)
MESSC (1941e), *Kazu-no-Hon 1 Kyoshi yo* (*Book of Numbers 1 for Teachers*), Nihon Shoseki Kabushiki Gaisha, pp. 1–91
MESSC (1941f), *Kazu-no-Hon 2 Kyoshi yo* (*Book of Numbers 2 for Teachers*), Kyodo Printing Co., Ltd., pp. 1–88 (from National Diet Library Digital Collections)
MESSC (1941g), *Kazu-no-Hon 3 Kyoshi yo* (*Book of Numbers 3 for Teachers*), Nihon Shoseki Kabushiki Gaisha, pp. 1–70
MESSC (1941h), *Kazu-no-Hon 4 Kyoshi yo* (*Book of Numbers 4*) *for Teachers*, Kyodo Printing Co., Ltd., pp. 1–54 (from National Diet Library Digital Collections)