

Article

Learning about the Coexistence between Nature and Humans in Elementary Science Education: Developing Lessons Using Folktales That Reflect Ancestors' Views on Nature

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Abstract: Understanding the coexistence between nature and humans is a basic concept required in modern society. In this study, we verify the effectiveness of folktales as teaching material in science education by incorporating folktales into the fifth-grade elementary school science unit, "Functions of Running Water and Changes in the Land". We investigate the effects of folktales that express ancestors' perspectives on nature on pupils' ideas about the coexistence between nature and humans. Additionally, we explore the possibility of using folktales in science education. In November 2017, an experimental group (74 participants) explored the coexistence between nature and humans through folktales, while a control group (60 participants) explored this coexistence through discussion activities. These experiments were conducted in fifth-grade classrooms at elementary schools in Hiroshima Prefecture, western Japan. Our results indicate that for some pupils in the experimental group, exposure to their ancestors' views of nature helped them develop and refine their ideas about their connection to and relationship with the river. Folktales vividly depict the nature of the past in the places where the pupils live, offering a glimpse into their ancestors' different views on nature that differ from present-day views. It is considered that, by coming into contact with the folktale, pupils were able to enter a situation that transcended time, allowing them to think about and empathize with the people who lived with the river. It is suggested that this connection is related to the results described above.

Keywords: coexistence between nature and humans; ancestors' view of nature; folktale; river; elementary school science



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1. Introduction

1.1. Ancestors' View of Nature and Science Education

The coexistence between nature and humans is one of the most basic concepts required for modern society. To achieve this, it is crucial to broaden our understanding of nature and the connection between nature and humans. This understanding is a psychological characteristic that includes the understanding that one is a part of nature, feelings about one's relationship with nature, and beliefs about one's experiences in nature [1,2]. In order to establish an understanding that "people are part of nature", education is required to encourage the creation of relationships between nature and humans [3].

Studies of place-based education have reported a number of educational practices that aim to discover the meaning of life and ways of living by nurturing one's relationship with all elements of the living place (nature, society, culture, history, traditions, etc.) [4,5]. In these reports, the relationship between the nature of everyday life and the culture and history that humans have shaped through their interactions with nature is emphasized [6,7]. By learning about nature from the perspectives of natural science, culture, and history,

students are able to understand the connection between nature and humans [8]. Shimono [9] suggests that by exposing students to their ancestors' views of nature, which are closely related to culture and history, it is possible to present them with an alternative view of the relationship between nature and humans compared to the modern view prominent today.

In Japan, since ancient times, nature worship, Shintoism, and Buddhism have influenced the view that the connection between nature and humans is crucial, and that nature is regarded as one with (or superior to) humans [10]. Learning about predecessors' views on nature provides students with an opportunity to reconsider their own perspectives on nature and to consider the connection and relationship between nature and humans, including themselves. However, no school practice currently exists that explores how the Japanese have historically viewed nature, how they have interacted with it, and whether they perceive nature as a part of their national culture [11].

Considering the above, ancestors' views on nature can be an effective tool for learning about the coexistence of and connection between nature and humans. This is especially noteworthy in science education, which aims to cultivate students' view of nature.

1.2. Folktales and Science Education

Stories that embody narratives are advocated as a way to teach concepts related to humanity through school science. Martin and Brouwer [12] mention that stories used by teachers to enliven lessons tend to help students expand their imaginations and reactions. Additionally, such stories can promote student participation because stories can simply and creatively illustrate natural objects and phenomena. Egan [13] demonstrates the use of a story format in elementary school science, employing myths such as "Prometheus stole a fire" and "The god Sol, his son, and Hephaestus" to teach the concept of "heat". The content of these myths is not necessarily correct according to scientific concepts; however, Egan believes that myths reflect humans' views on nature and are therefore useful as a tool to understand scientific concepts. Enfield and Mathew [14] propose a model science lesson using picture books, arguing that the lesson excites students' imaginations and enhances their motivation to think about scientific concepts. This means that stories are an effective method for inquiry and understanding of the natural world. Using stories in science lessons promotes an interest in nature and motivates children to learn, expanding their imagination for and reactions to the natural world.

Folktales, which are components of storytelling, were a means of education that conveyed wisdom and skills essential to local communities and villages in eras when educational institutions such as schools did not exist [15,16]. Additionally, they are used for entertainment and have the effect of shaping and enhancing people's beliefs, attitudes, and values [17].

Folktales depict wide and rich worlds that cannot be categorized by current academic disciplines such as the natural sciences, humanities, and social sciences [16]. These stories provide information as to the kind of interests and concerns the Japanese once had in their surrounding natural environment, in the absence of modern educational influences. Miyahashi and Saiki [18] investigated Japanese interest in natural phenomena using approximately 3400 folktales collected from various regions of Japan and found that 717 of the 3407 stories (21%) expressed an interest in nature. When categorized by the existing science subjects, there were no stories related to physics or chemistry, but most of the stories were related to biology (67%) and geology (23%), including accounts of earthquake and volcanic activity. For example, one folktale related to biology is "Serpent of Yohoga Pond", which features a giant snake that lived in Yohoga Pond in Shimane Prefecture in western Japan. A folktale related to geology is "Straw Dragon of the Rain Prayer", set along the Nagara River flowing through Gifu Prefecture in central Japan [16].

The following is an outline of the folktale "Serpent of Yohoga Pond".

A hunter was taking a nap by a pond when he was almost eaten by a serpent living in the pond. He fired his gun into the serpent's mouth. The wounded serpent escaped into the Sea of Japan, where it died. When the corpse was caught

in a fisherman's net, there was talk at first of worshipping it as a messenger of the Dragon Palace. However, in the heat of the moment, a young fisherman ate its flesh. As a result, a plague spread throughout the region.

In many folktales in which snakes are mentioned, the snake, a familiar creature, is deified as a water god that brings floods, droughts, and epidemics. This folktale conveys the contagion of a plague caused by not paying respect to the sacred snake and eating it in the heat of the moment.

The following is an outline of the folktale "Straw Dragon of the Rain Prayer".

A relatively affluent village near the Nagara River experienced a summer without rain. The villagers made a dragon out of straw to pray for rain, and the dragon jumped into the Nagara River, and rain began to fall. However, the rain did not stop, and it became so heavy that it caused a flood, and the fields were washed away. The villagers prayed again, and the dragon rose from the Nagara River into the sky, and the rain stopped.

This folktale is a gentle story about the various benefits of living in the Nagara River basin and the inevitability of floods and other water damages. Furthermore, dragons and snakes are the objects of water god beliefs depicted in folktales in which rivers and water are mentioned.

Folktales about natural phenomena offer a vivid reflection of ancestors' views on nature, that is, how they saw, felt, and lived with nature. For example, folktales about natural disasters such as floods express the fact that ancestors saw nature as a threat, but also felt its benefits and coexisted with it. Therefore, through folktales, we come into contact with ancestors' views and ideas about nature that are different from those of today. We can then use those views to think about the coexistence and relationship between nature and humans.

Folktales are considered to be effective teaching materials for thinking about the coexistence between nature and humans, but they have been used exclusively in language education, with few examples in science education. In the U.S., Meyers [19] developed a project titled "Sky Teller Project" and successfully increased elementary school students' interest and motivation in space science by incorporating folktales about space into science education. Lebofsky et al. [20] used folktales from two tribes in eastern Canada to help students understand scientific concepts about the earth's rotation on its axis and its revolution around the sun. In Japan, however, the use of folk tales in science education was not considered, and their effectiveness as teaching materials has not been fully investigated [21].

1.3. Focus of the Study

The objective of this study was to examine the effectiveness of folktales as teaching materials in science education in Japan, and to explore the possibility of using folktales in elementary science education by incorporating them into the fifth-grade earth science unit, "Functions of Running Water and Changes in the Land". The research questions (RQ) that guided this study were as follows:

RQ1. *How can science lessons be developed to use folktales which reflect ancestors' views of nature, in particular how nature and humans coexist?*

RQ2. *What are the effects of such lessons on pupils' understanding of how nature and humans coexist?*

2. Materials and Methods

2.1. Developed Lessons

The subject unit is the fifth-grade elementary school science unit "Functions of Running Water and Changes in the Land". The aim of this unit is to develop pupils' understanding and skills in observation and experimentation. This will be achieved by focusing on the speed and quantity of flowing water, controlling these conditions, and investigating functions of running water and changes in the land. This unit further aims to develop students' problem-solving abilities, mainly based on predictions and hypotheses, and to

encourage independent problem solving. In addition, in connection to daily life, pupils are expected to apply these learnings to natural disasters caused by overflowing rivers because of long and torrential rains.

In this study, two lessons incorporating folktales were devised as supplementary content positioned after the unit content presented in the textbooks. The goal of the lessons was to develop pupils’ knowledge about the coexistence between rivers and humans (the connection and creation of a relationship between rivers and humans). In line with the purpose of the study, an experimental group was designed to think about the coexistence between nature (rivers) and humans through folktales, and a control group was designed to think about the coexistence between nature (rivers) and humans through discussion activities among pupils, without using folktales. Table 1 shows the development of the lessons’ design. The lessons were conducted in November 2017 with 134 fifth-grade pupils (10–11 years old) from elementary schools in Hiroshima Prefecture in western Japan. Out of 134 students (5 classes) in the fifth grade, 74 (3 classes) were set up as the experimental group and 60 (2 classes) as the control group, after adjustment to avoid differences in group sizes as much as possible. Each class is divided in such a way that there are no large academic differences; therefore, there was no significant difference in academic performance between the two groups. The lessons took place over two days. The first lesson was conducted in each class on the first day, and the second lesson was conducted in each class on the second day, one week later. No other science classes were included during that time. These lessons were put into practice by the first author as a guest teacher, while the second author assisted with recording the lessons.

Table 1. Development of the lesson design.

First period: investigate the causes of flooding in the Ota River.	
(1) Learn about the benefits and fury of the Ota River. Q. How does the Ota River affect our lives? Benefits: Water for domestic use, agricultural use, landscape, swimming, and fishing. Fury: Floods, storm surges, and other water damage.	
(2) Investigate the factors contributing to flooding that the Ota River has caused. Q. Why does the Ota River cause flooding? Weather factors: swollen river due to heavy rain. Topographic factors: many bends prone to erosion. Some areas are zero meters above sea level.	
(3) Become aware of issues regarding the future relationship between the Ota River and humans which will bring both benefits and fury. Q. How should we deal with the Ota River?	
Second period: think about the coexistence between the Ota River and humans.	
Experimental group	Control group
(1) Learn about flood control measures. Q. What are humans doing to prevent flooding and reduce damage from the Ota River? Science and technology: dams, levees, Ota River spillway.	
(2) Consider whether science and technology can completely manage rivers. Q. Can humans completely manage rivers and prevent flooding through science and technology?	
(3) Think about the connection and relationship between rivers and humans as depicted in folktales. Q. How did ancestors relate to the Ota River? Q. Why did ancestors leave us folktales? Q. How should we deal with the Ota River?	(3) Think about the connection and relationship between rivers and humans through discussion activities. Q. How should we deal with the Ota River?

The elementary school where the study was conducted is located in the watershed of the Ota River (a first-class river in Japan), which flows through the western part of Hiroshima Prefecture. The Ota River has long been used for agricultural purposes. Following

World War II, when living standards improved and industry developed, the demand for water increased, and the river played a crucial role as a source of water for daily use in Hiroshima City and the surrounding cities and towns. Floods have repeatedly caused damage and loss of lives and property over the years. As a flood control measure, the people of Hiroshima constructed the Ota River Spillway, an artificial river to control the volume of water in several rivers flowing in the estuary of Hiroshima City, greatly improving safety through flood management.

The folktale “Serpent Who Saved the Forest” was chosen as the folktale to be used in this lesson. The translated worksheet for the folktales is shown in Figure 1. Since there is no English translation of this folktale, it was translated by the first author and the content was checked by the second author and a native English speaker during the writing of this paper. This folktale was set along the Minochi River, a tributary of the Ota River, and reflects the typical Japanese ancestor view of nature, as proposed by Maebayashi [22]. That is, (1) nature is a constantly changing entity, (2) nature is not an object for humans to manipulate and conquer, and (3) nature and humans are interconnected, and humans are part of nature (Table 2).

Serpent Who Saved the Forest

Once upon a time, it rained in the Mori area daily, causing a great flood in the Minochi River.

People did everything they could to prevent the flood, but the river flowed much faster than they expected.

They said,

"The rice paddies are flowing away, but with this rain, there is nothing we can do about it."

"Please let the rain stop soon and the river recede."

In spite of their pleas, the river overflowed, and it seemed as if the Mori area would be swept away at last.

Just then, however, a serpent appeared from under the spring water and swam along the banks of the overflowing river.

The serpent intercepted the water, and the water flowing into the Mori district suddenly stopped.

People were grateful to the serpent for saving their houses and fields.

When the rain stopped and the river calmed down, the serpent quietly disappeared.

People built a small shrine where the serpent's head and tail had been when it stopped the flowing river, and called it

"Ide-gami," meaning "God of spring water," to honor the serpent forever.



Figure 1. Folktale “Serpent Who Saved the Forest”.

The author visited the river where the folktale was set and conducted a field survey, confirming the presence of two small shrines that appeared in the folktale. These shrines were built where the head and tail of the serpent in the folktale are believed to have been. To help the pupils visualize the folktale sites, a photograph of the shrines was included in the worksheet. An aerial photograph of the locale where the folktale took place was included.

Table 2. Ancestors' views on nature contained in the folktale "Serpent Who Saved the Forest".

Ancestors' Views on Nature	Content of the Relevant Folktale
(1) Nature is a constantly changing entity.	Villagers experience the biggest flood they have ever experienced.
(2) Nature is not an object for humans to manipulate and conquer.	The villagers could do nothing about the flood, but a serpent came out of the river and prevented the flood.
(3) Nature and humans are interconnected, and humans are part of nature.	The villagers were grateful to the serpent for protecting them from the flood and built a shrine to worship the serpent as a god.

It was expected that the pupils in the experimental group would learn about the ancestors' views on nature through this folktale, that they would have an opportunity to think about whether they currently hold such views on nature, and how they would relate to the Ota River in the future if they accepted the ancestors' views on nature.

2.2. Objective and Method of the Survey

A questionnaire survey was conducted before and after the lessons. The survey asked about the connection between the river and humans (Q1) and building a relationship with rivers that cause flooding (Q2; Table 3).

Table 3. Survey period and content.

Question No.	Survey Period	Question
Q1.	Before lesson	Have you ever thought about the relationship between rivers and humans? If so, what are the connections between them?
	After lesson	What are the connections between rivers and humans?
Q2.	Before and after lesson	How will you deal with the river from now on?

When analyzing the survey responses, Yamada et al. [23], who investigated elementary and junior high school students' views on living in harmony with nature, was used as a reference. According to them, views of coexistence with nature are defined as (1) a content category that expresses thoughts and feelings arising from familiarity with nature (Affinity for nature, e.g., I want to do something to protect nature), (2) a category that expresses awareness of the relationship between one's life and nature (Relationship between nature and life, e.g., I think my life is supported by nature), and (3) a category that expresses attitudes and ideas that form the basis for choosing nature-friendly behavior (interest in and concern for nature, e.g., I want to know more about how nature works). Therefore, we qualitatively analyzed the pupils' responses by regarding Question 1 as corresponding to the "Relationship between nature and life" category and Question 2 as corresponding to the "Affinity for nature", "Relationship between nature and life", and "Interest in and concern for nature" categories.

The analysis procedure was as follows: first, each response was tentatively labeled (open coding). Next, responses were subcategorized by similar content, and each given a name. Then the subcategories were grouped into the three categories described above. Categories were formed for responses that did not fit into any of the three categories. These steps were undertaken based on the consensus of the first and second authors.

3. Results

3.1. Progress of the Lessons

3.1.1. The First Period Lesson

In the first period, which was the same for both the experimental and control groups, pupils learned basic information about the Ota River (such as its length and number of tributaries), using a map. After that, pupils thought about the benefits of the Ota River and mentioned “access to water necessary for daily life”, “beautiful scenery”, “swimming”, and “fishing” as benefits, confirming that our lives are made possible by the existence of the Ota River. Next, “flooding due to heavy rainfall” was mentioned as one of the most ferocious features of the Ota River, and the question of whether there are other factors besides heavy rainfall that cause flooding was raised. The causes of flooding in the Ota River were investigated, including weather and topographical factors. The materials used in the study included data on monthly precipitation in Hiroshima Prefecture and the number of typhoons that approached Hiroshima between 2013 and 2017, aerial photographs of the Ota River basin, and color-coded data on the elevation of Hiroshima City. Pupils focused on the following questions: “When is there heavy rainfall in Hiroshima and when does flooding cause heavy rainfall?” The analysis of pupils’ answers clarified that “Hiroshima City receives a lot of heavy rainfall when flooding occurs, and that heavy rainfall occurs during the rainy season and typhoons”, “the Ota River has many meanders”, and “Hiroshima City is at an elevation almost as low as the sea”. The study revealed that the Ota River is prone to repeated flooding, influenced by both meteorological and topographical factors.

3.1.2. The Second Period Lesson

In the second period, both groups had the same lesson content as in Table 1: (1) learning about flood countermeasures (science and technology: dams, levees, and the Ota River spillway) and (2) considering whether science and technology can completely manage the river. The pupils discussed measures to protect themselves from flooding. Although some pupils had prepared disaster prevention supplies, most of them had not taken measures to protect themselves from floods from the perspective of self-help, which is to think about what they can do and carrying it out. To encourage pupils to think about self-help flood countermeasures, dams, reservoirs, levees, and warnings were discussed as public flood countermeasures, and the Ota River spillway was introduced as a local flood control measure. Such flood countermeasures from a public assistance perspective are collectively referred to as flood countermeasures in science and technology fields, with students confirming that human wisdom (science and technology), cultivated over a long period, has protected us from floods. However, when the question, “Can we completely manage rivers and prevent floods with human science and technology?” was posed, some pupils answered, “science and technology are advancing day by day, and I thought we can manage rivers in the future, even if we cannot now, because I think the frequency of flood damage is actually decreasing compared to the past”. The pupils understood that science and technology has rapidly advanced, and that humans will be able to manage rivers and prevent floods in the future. Other pupils answered that “the forces of nature cannot be suppressed by humans” and “nature cannot be managed because it is not 100% predictable”. This indicates that the pupils understood that the forces of nature are more powerful than they thought and that nature is not subject to human management. The need to rethink how we interact with nature was highlighted because scientific technology can reduce but not completely eliminate the damage caused by floods. In other words, we cannot completely manage rivers. The following is a description of the progression of the lesson, highlighting the variation in learning content between the experimental and control groups.

To think about the relationship between rivers and people through folktales in the experimental group, we introduced the folktale “Serpent Who Saved the Forest”, a story about people who lived in harmony with rivers in an age when science and technology were not as widespread as they are today. Then, pupils thought about “what the people in the

folktale want to tell us about the way they used to live with the Ota River". Several pupils were interested in the story of the shrine, and the serpent coming out of the spring water in the folktale. Students noticed that their viewpoints and those of their ancestors differed regarding how each group saw the river. In their worksheets, the pupils wrote, "rivers were alive, mysterious, and sacred", and "floods are terrible and cannot be prevented by humans because serpents, not humans, prevented floods". In this way, the pupils captured their ancestors' view of the river. The pupils then thought about what they should do to deal with the Ota River, which causes floods. They wrote, "it is important to prepare for floods without relying too much on science and technology", "although the river causes floods, we are grateful for the help it gives us every day", and "to think about how to deal with the river and to have an awareness of disaster prevention, I will tell this folktale to many people", indicating that the folktale was a considerable reference. These statements indicate that folktales are helpful. However, some pupils wrote about how to interact with the river without referring to any folktales or ancestors' views on nature.

The control group reviewed the connection and relationship between rivers and people through discussion activities. Here, pupils discussed how to deal with rivers that cause flooding based on their own knowledge and life experiences. Many of the pupils offered concrete measures to protect themselves, such as "decide on an evacuation site", "stay away from the river after rains", and "evacuate to higher ground if a flood occurs". A small number of pupils also suggested that "it is crucial to protect ourselves from floods using science and technology", and "minimize the damage caused by floods with the help of science and technology". These suggestions showed that there were two distinct groups of pupils: those who thought about the importance of self-help and those who thought of public assistance. However, the pupils confirmed that self-help is crucial in the relationship between humans and rivers that cause floods.

3.2. Results of the Questionnaire Survey

3.2.1. Results of Q1

In the category "Relationship between nature and life", 31 of 74 pupils in the experimental group and 31 of 60 pupils in the control group answered "I had thought about the relationship between rivers and humans" before the lesson. This response was obtained from approximately half of the total number of pupils in both groups. After the lesson, however, 63 pupils in the experimental group and 50 pupils in the control group responded in this manner, representing an increase in the number of respondents.

The breakdown of the responses is shown in Figure 2a for the experimental group and Figure 2b for the control group. Examples of the pupils' subcategory answers are shown in Table 4. Insufficient answers were considered those that did not describe the connection specifically, such as "There are many connections between rivers and humans" or "There is a close connection between rivers and humans".

There were no considerable differences in the type of subcategory before and after the lessons in both groups. However, in the subcategory of "Humans receive benefits from the river, but at the same time are exposed to the fury of floods", which is the basis for the concept of coexistence between nature and humans, the number of respondents in the experimental group increased significantly from one to nineteen, while the number of respondents in the control group increased from two to eight. The same was observed for the concept of coexistence between nature and humans. Similarly, in the subcategory of "Nature and humans support each other", which is another basis for the idea of coexistence between nature and humans, the number of participants in the experimental group increased significantly from one to eleven, while the number of participants in the control group increased from one to four.

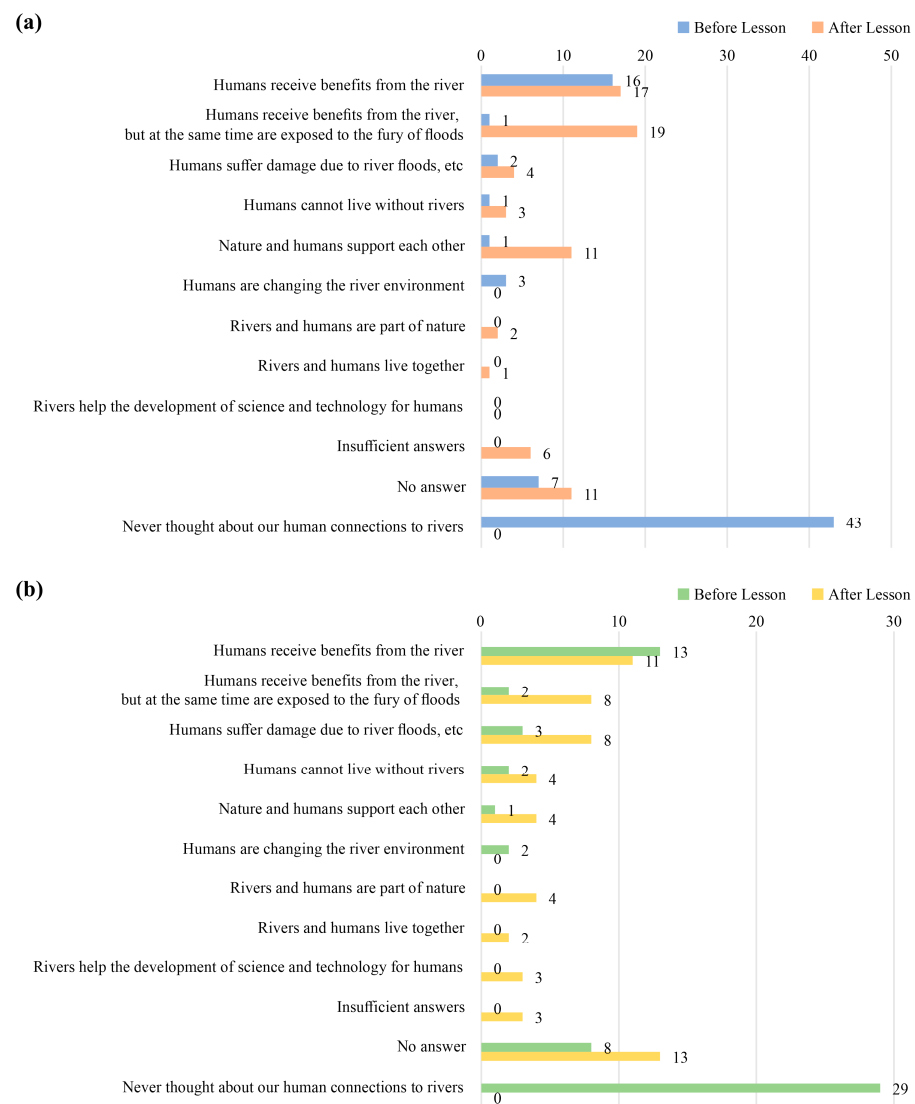


Figure 2. Pupils' answers to the question, "What are the connections between rivers and humans?" (a) Experimental group and (b) control group.

Table 4. Examples of the pupils' subcategory answers in Q1 (multiple-response subcategories only).

Subcategory	Examples of Pupils Answers
Humans receive benefits from the river.	The river makes agriculture more efficient.
Humans receive benefits from the river, but at the same time are exposed to the fury of floods.	Rivers provide water for humans, and we can fish there. But they also cause flooding.
Humans suffer damage due to river floods, et cetera.	Rivers are dangerous for humans because we can drown in them.
Humans cannot live without rivers.	Even if we wanted to leave each other, we couldn't.
Nature and humans support each other.	For humans, rivers are familiar and support us.
Humans are changing the river environment.	Humans destroy rivers.
Rivers and humans are part of nature.	Rivers and humans are both part of the same nature.
Rivers and humans live together.	Rivers and humans live together.
Rivers help the development of science and technology for humans.	Rivers help the development the science and technology of humans.

3.2.2. Results of Q2

The breakdown of the responses to Q2 (Building a relationship with rivers that cause flooding) is shown in Figure 3a for the experimental group and Figure 3b for the control group. Examples of the pupils' subcategory answers are shown in Table 5.

First, the results for the experimental group show that, except for non-responses, approximately half of the responses before the lesson belonged to the subcategory of "Take care of the river" in the category "Affinity for nature", but after the lesson, the number of responses belonging to the subcategories of "Have knowledge of rivers", "Be aware of floods" in the categories "Interest in and concern for nature" and "Take care of rivers" increased significantly. In addition, results following the lessons showed a variety of subcategories that were not seen before the lessons. These included "Appreciate the benefits of the river" in the category "Affinity for nature", and "Pass on the dangers of the river to the future", "Recognize that the river is nature", "Human movement according to the river conditions", and "Remember what our ancestors wanted to tell us", in the category "Interest in and concern for nature". Five pupils expressed the idea of "Manage the river with science and technology as much as possible" before the lessons, and three of them consistently held the same idea after the lessons. However, when we focused on the two pupils who changed their minds, both of them answered "Observe the river and weather on a regular basis (e.g., observe nature with your own eyes without relying too much on science and technology)" and "Have river knowledge (e.g., know about the river and prepare for disasters)" in the subcategory of "Interest in and concern for nature" after the lessons.

Table 5. Examples of the pupils' subcategory answers in Q2 (multiple-response subcategories only).

Subcategory	Example of the Pupil's Answer
Take care of the river.	Take care of and protect the river.
Appreciate the benefits of the river.	Live your daily life while being thankful for the river.
Coexist with the river.	Prepare to protect our lives in the event of a flood and live with the river.
Manage the river with science and technology as much as possible.	Prevent flooding with the maximum science and technology available today.
Beware of flooding.	Always be careful and watch the river and weather.
Have knowledge of the river.	Have wisdom about floods without relying too much on science and technology.
Be aware of floods.	Remember and be aware that floods happen.
Stay away from rivers during heavy rainfall.	Stay away from the river on rainy days.
Protect yourself during a disaster.	Be prepared to protect myself in the event of a flood.
Observe the river and weather on a daily basis.	Observe the river with my own eyes and touch the river with my own hands.
Recognize that the river is nature.	Rivers are dangerous, but they are natural. So, people should stop building too-high levees.
People help each other.	When flooding occurs, people help each other.

Next, the results for the control group showed that, with the exception of no responses, approximately half of the respondents belonged to the subcategory of "Take care of the river" in the category "Affinity for nature" before the lessons. However, after the lessons, the number of respondents belonging to the subcategories of "Have knowledge of rivers", "Observe the river and weather on a daily basis", "Be aware of floods", and "Stay away from rivers during heavy rainfall" in the category "Interest in and concern for nature" increased significantly. Two pupils consistently expressed the idea of "Manage the river with science and technology as much as possible" before and after the lessons. Furthermore,

the pupil who answered “Nothing to worry about” as a subcategory of “other” before the lessons answered “people help each other” after the lessons.

There were no considerable differences in the change in responses before and after the lessons when comparing the experimental and control groups, but the experimental group showed a greater variety of subcategories than the control group after the lessons. One of these subcategories was “Appreciate the benefits of the river”, which is a subcategory of the category “Affinity for nature”. Other subcategories included “Pass on the dangers of the river to the future”, “Recognize that the river is nature”, “Human movement according to the river conditions”, and “Remember what our ancestors wanted to tell us”, in the category “Interest in and concern for nature”, although the number of respondents for these subcategories was small.

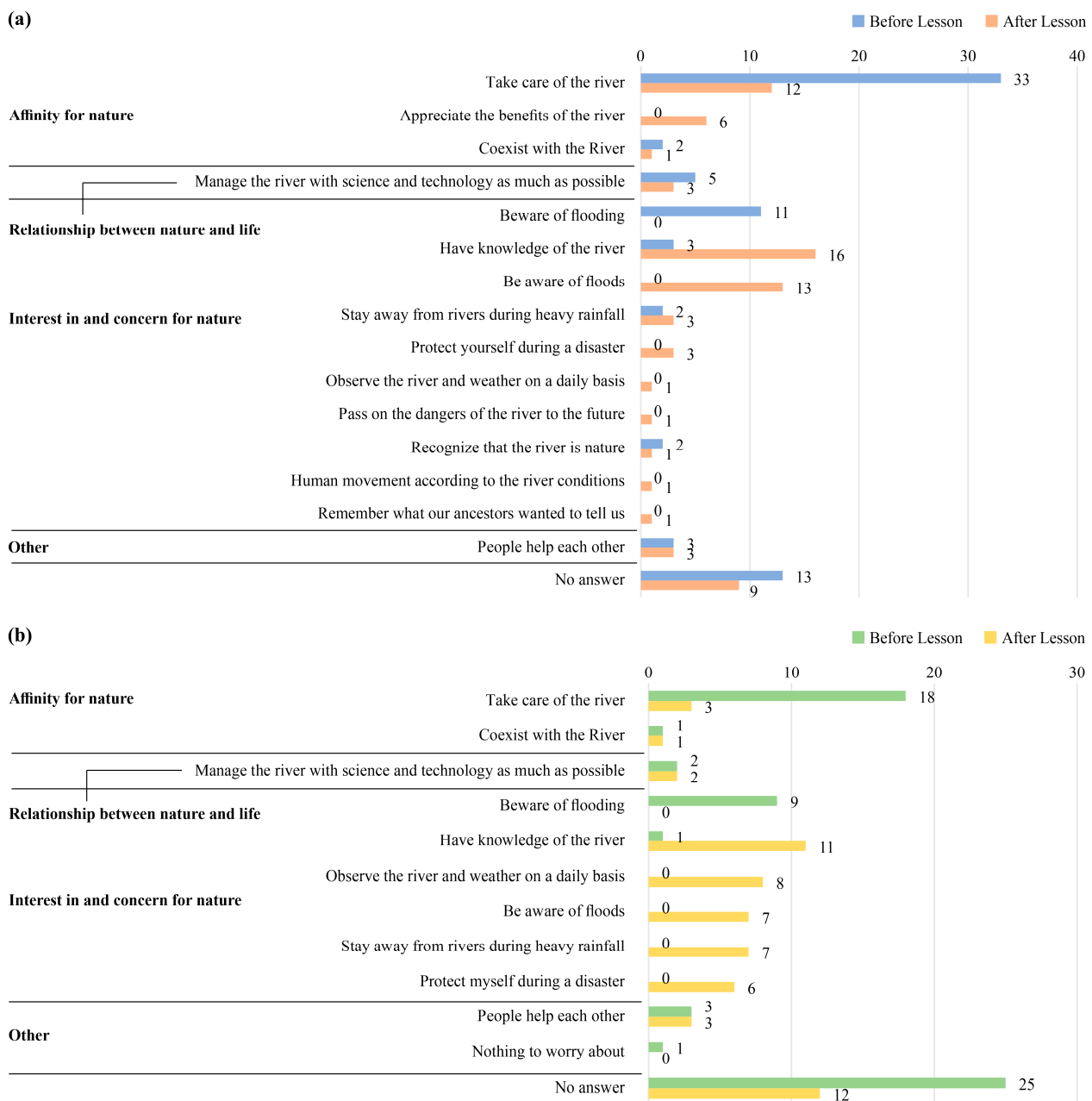


Figure 3. Pupils’ answers to the question, “How would you deal with the river from now on?” (a) Experimental group and (b) control group.

4. Discussion

In this study, lessons were designed and implemented to think about the coexistence between nature (a river) and humans by making use of ancestors' views on nature as expressed through folktales. As a result, it became evident that some pupils broadened their ideas about the relationship between the river and themselves by coming into contact with these ancestors' views.

In the results of Q1 (Connection between nature and humans), the experimental group showed a considerable increase in the subcategories of "Humans receive blessings from rivers but are exposed to the fury of floods" and "We support each other", which form the basis for the concept of coexistence between nature and humans. The folktale, "Serpent Who Saved the Forest", describes how the villagers, who had been relishing the benefits of the river, experienced a flood that destroyed the life they had built over a long period of time, resulting in fear of the river. We thought that the pupils in the experimental group empathized with these contents of the folktales.

In addition, although the number of respondents in the experimental group was small, their responses to Question 2 (Building a relationship with the river that causes flooding) indicated a variety of ideas, such as "Pass on the danger of the river to the future", "People move according to the river conditions", "Recognize that the river is nature", and "Remember what our ancestors wanted to tell us (that humans cannot manage nature)". From these responses, it can be inferred that the pupils in the experimental group gained insights from the ancestors' views on nature through the folktales, in which the people of the stories were not in control of the river, but rather lived in accordance with the river's conditions. The reason for these results may be that folktales vividly describe the past nature of the places where people lived and depict the ancestors' views on nature, which were different from those of the present day.

This study suggests that, in school science, when thinking about and deciding how to live in nature, it is crucial to consider "the thoughts of people who have been involved with nature". By presenting such opportunities to pupils, they can learn how people have perceived and lived with nature throughout our long human history and can think about the complex and close relationship between nature and humans. This is connected to Orr [6] and Gruenewald and Smith's [7] work, which suggests that to cultivate a relationship with nature, it is necessary to incorporate the relationship between the nature in which we live and the culture and history that humans have shaped in their interactions with nature into education. While it is fundamental to learn about natural things and phenomena in the field of school science, it is also important to learn through ancestors' views on nature to fully understand the idea of the coexistence between nature and humans. This is especially true for elementary school science, which is the foundation for cultivating ideas about the coexistence between nature and humans. Therefore, incorporating a variety of approaches will enhance the educational significance of science as a subject.

It could not be overlooked that some pupils in this lesson did not have a comprehensive image of their ancestors' views on nature. In this lesson, the instructor did not specifically mention the ancestors' views on nature, and the pupils were left to imagine them freely, resulting in differences among the pupils' views. The results of Q2 show that some pupils in both groups consistently held the idea of "Manage the river with science and technology as much as possible" before and after the lessons. In the case of the experimental group, even though they learned about ancestors' views on nature through folktales, their trust and pride in science and technology and their view that we must manage nature, which causes disasters, to live a secure life remained unshaken. As a background to this, it is necessary to understand the backgrounds of the pupils in advance, as the understanding, acceptance, or rejection of the alternative view of nature varies among the pupils.

5. Limitations and Future Research

One of the issues that emerged from this practice was the wide range of ancestors' views on nature that could be read from the folktales. Perceiving and accepting them was

then left up to the readers. In this study, the instructor presented the pupils with “what the ancestors in the folktales want to tell us about how they interacted with the Ota River”, but the pupils’ ideas varied, and some were unable to expand on their ideas. Therefore, when using folktales in the classroom, it is essential for pupils to have reading comprehension and imagination, and it is highly likely that their reading studies in the Japanese language class and their previous basic academic skills will have a significant impact. As mentioned in the discussion, even if pupils can read the ancestors’ views on nature, it is up to them to decide whether or not they can incorporate them into their own ideas. In other words, the ancestors’ views on nature that can be read from folktales may not be useful for all pupils. Considering this possibility, further research on science education using folktales should be continued.

In this study, the science lessons were developed utilizing ancestors’ views of nature as depicted in folktales, incorporating an element of Traditional Ecological Knowledge (TEK) learning. TEK began as a field of study in ethnoscience research and is defined as an integrated body of knowledge, beliefs, and practices accumulated by indigenous peoples through their interactions with the entire environment, including society and nature [24]. Although folktales and indigenous peoples’ views of nature were not analyzed from a TEK perspective in this study, future research on science education using folktales should be conducted from a TEK perspective to enrich the subject.

Another concern is that in some local areas, folktales about the target nature topic may not be available. In this study, the selection of schools and the development of lessons started with the question of whether folktales existed in the local area that could be used in the lessons. However, if folktales from the local area are not used in the classroom, their educational effect is expected to be reduced by half. Verification of this fact will be required in the next study.

6. Conclusions

The objective of this study was to develop and implement a lesson using folktales in the fifth-grade elementary school science unit “Functions of Running Water and Changes in the Land” and to explore the possibility of using folktales expressing ancestors’ views on nature in science education as a method of influencing pupils’ ideas about the coexistence between nature and humans.

The results of the questionnaire survey conducted before and after the lessons revealed that, although only a small number of pupils were exposed to the ancestors’ views on nature through folktales, their ideas about the connection and the creation of a relationship between nature and humans were enriched. Thus, when learning about the connection between nature and humans and the creation of a relationship between nature and humans in science, it is further effective to approach the subject from the perspective of culture and history related to nature, such as ancestors’ views on nature. In this study, the lessons were developed only for the unit on “Functions of Running Water and Land Change” in the earth science field, but it may further be used in units on “Weather”, “Volcanoes”, “Space”, and “Natural Disasters Other Than Floods (Earthquakes, Tsunami, etc.)” in the earth science field. In the biology field, our method may be used in units related to “Animals” and “Plants”. In elementary school science in Japan, the sixth-grade “Biology and Environment” unit deals with the coexistence between nature and humans in earnest. In other units, although coexistence is touched upon, it is rarely studied as a main topic. However, by introducing and incorporating folktales that reflect ancestors’ views on nature as an extension of each unit of study, as in this practice, we expect that the experience of thinking about the coexistence between nature and humans will accumulate in the pupils’ minds, helping them to take actions toward coexistence.

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