

Development of Storytelling Program for Science Learning Utilizing Local Myths as Contents

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ABSTRACT

Existing science education that excludes narrative thinking impedes the understanding of the context of workbook content. The object of this research is to develop a storytelling-learning program based on narrative thinking to elevate learners' interest in science and expand their inventive problem-solving abilities. Following an analysis of the current Korean curriculum, eight types of storytelling materials that utilize local content were developed for grades 7–9. The learning program used quest storytelling and was designed such that learning activities such as investigation, discussion, and experimentation were included in the process of solving each quest. Learners experienced an interest in storytelling learning resulting from participation in this storytelling-learning program. Moreover, learners demonstrated inventive problem-solving abilities in the process of completing the stories. During the process of assembling the storytelling materials, the students interacted with enthusiasm and generated ideas. The teachers indicated a positive feedback to the storytelling program as a new attempt to stimulate learners' interests. In the future, with continuous development and application, storytelling-science-learning programs that base science learning on narrative thinking are expected to be successful.

Key words: Local Contents, Narrative Thinking, Storytelling, Science Learning.

1. INTRODUCTION

As recent education has gained the characteristic of 'creativity and convergence', storytelling is drawing attention in the process of teaching and learning. Accordingly, the functions and meanings of storytelling have actively been reviewed. In particular, Fisher [1] focused on the human ability of storytelling and emphasized that storytelling is the oldest and most universal communication form.

Narrative thinking has been discussed in relation to storytelling. Bruner [2] emphasized narrative thinking as a concept that contrasts with paradigm thinking that deals with objects in the physical world. In particular, he focused on the point that narrative thinking deals with issues in human life. In other words, narrative thinking has the structure of described stories and this structure is formed by restructuring human experiences. In addition, paradigm thinking is differentiated from narrative thinking by the fact that paradigm thinking is logical, adjusting, and scientific, whereas narrative thinking relies on the context and creates unpredictable stories.

In line with active discussions on narrative thinking, it has been argued that this should be introduced in the education field. Special emphasis was placed on the contemporary world's need to avoid cramming one's head with encyclopedic

knowledge and to teach in a way of tracing information routes [3]. While doing so, Kang he also argued that learning should be changed to narrative thinking that suggests circumstances and explores routes to resolve corresponding problems rather than memorizing information. As part of efforts to prevent the empowerment of scientific knowledge centered on principles and laws, a study stressed narrative thinking [4]. In particular, as a measure to self-examine our educational culture biased toward scientific thinking and to seek an alternative, narrative thinking drew attention [5], [6]. Accordingly, studies have been conducted on teaching methods that introduced narrative way of thinking and 'stories' in order to teach various subjects such as Korean language, history, and social studies [7] - [11].

However, unlike other subjects, attention and access to 'stories' have been extremely limited in the field of science education due to the characteristic of paradigm thinking held by science. In the overseas field of science education, the development of storytelling learning programs has been studied [12]. In Korean science education, however, few such attempts have been made. They developed an approach utilizing the data of science history as a method for teaching science using stories, and designed story telling programs in the science of electricity,

In science education, studies related to narrative thinking have only suggested the need to introduce narratives, but did not suggest concrete utilization methods. However, in light of the constructivism theory that is emphasized in today's science education, narrative thinking is a thinking method that also

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Manuscript received Jun. 12, 2014; revised Jul. 28, 2014;
accepted Aug. 04, 2014

plays a very important function when students construct meanings. However, based on the theory of constructivism emphasized in science education today, narrative thinking is a very important process through which learners construct meaning. Therefore, it is worthwhile examining the possibility of a narrative-based learning strategy. Particularly, storytelling techniques based on narrative thinking are related to the experiences of learners in various ways. Because big and small stories are learned through various human activities including communication and information storage, it may be that everyone experiences storytelling. Therefore, an examination of the potential of narratives as a learning strategy is considered very meaningful.

In Korea, however, there is a side to science education that has nothing to do with narrative thinking. 'Science making' activities had to be introduced to analyse of the meaning that narrative thinking carries in science education [13], which drew attention to the lack of narratives in the Korean science curriculum. In other Korean research, the narrative character of science teaching methods was considered in a study [14], which analyzed the types and features of knowledge that pre-service science teachers form through narrative research methods [15]. As the above summary shows, previous studies of storytelling in the science education field in Korea have been exceedingly limited.

It is possible that storytelling learning programs may raise students' interest in and concern with science; previous research [16] has indicated that it is less effective as interest in and concern about science rise in the higher grades. Therefore, in this study we try to develop a storytelling learning program based on the narrative thinking of the learners.

Myths are particularly applicable in connection with storytelling. Because myths are story forms that contain elemental meanings on multiple levels, they are a significant source of content [17].

When we consider the presupposition that a narrative contains a story, the narrative characteristics of myths are clearly evident in their epic story structure [18]. In addition, because myths and legends of all the countries of the world have universal as well as unique characteristics, their contents express the original form of a story in various manifestations. Therefore, in this study we attempt to use myths to introduce narrative thinking into science learning.

The research problems of this study are following. First, it will explore whether local myths can be used as the contents of learning for a science class. Second, it aims to develop a storytelling program based on learners' narrative thinking.

2. METHODS AND PROCEDURES

2.1 Curriculum analysis and extraction of storytelling content materials

2.1.1 Analysis of learning content

We based our learning content analysis of science courses in Korea on the revision curriculum, which was applied in the 7th grade in 2010. Within this curriculum [19], we analyzed

middle school textbook contents; our analysis was based on the Ministry of Education, Science and Technology handbook(2008). In addition, the unit and the learning title introducing the content of a myth through the middle school science curriculum analysis in Korea were extracted.

2.1.2 Extraction of storytelling content materials

To locate the storytelling plots of this study we examined various tales from many regions in Korea. Through literature and internet searches we researched not only the Dangun birth myth, which is called the birth myth of Korea, but also regional tales. Table 1 presents our compilation of sources of materials for building storytelling contents. The basic content of the myth selected as the summary of storytelling was reconstructed at the level of middle school students.

2.2 The development of the storytelling learning program

2.2.1 Preparation of pedagogical content knowledge

In the teaching-learning process, pedagogical content knowledge is what is directly implemented. The teacher's knowledge is not directly conveyed to students, that is, the knowledge of a teacher needs to be transformed into a form which students can understand.

Shulman [20] explained that the knowledge of teachers is divided into content knowledge, pedagogy knowledge, pedagogical content knowledge and curriculum knowledge. He defined pedagogical content knowledge as the knowledge that teachers use to organize the contents of a subject into an easily teachable form. This can be explained by the knowledge of the new area in which the content knowledge and pedagogy knowledge are integrated. Therefore, a teacher's content knowledge and pedagogy knowledge need to be reorganized into the form of pedagogical content knowledge for learning programs to be educationally effective. Even if teachers have the necessary knowledge, there are many cases in which it is not effectually delivered to students [21]. In cases in which pedagogical content is united with inappropriate teaching methods it may be necessary to reconstruct knowledge of the subject being taught.

Therefore, in this research, the storytelling description method as a teaching-learning method that is used in the teaching-learning process to change knowledge about workbook content into concrete pedagogical content knowledge was prepared, and storytelling materials were reconstructed according to it.

Table 1. Storytelling Resource Materials

Author	Year	Title	Publisher
Kim, Nanju	2007	The myth of Korea from the view point of Jun's psychology	Jipmundang
Kim, Sooni	2001	The legend and myth of Jeju	Jeju culture
Kim, Jinyoung	2009	The myth of Korea	Syinsa
Kim, Whakyung	2002	The myth of Korea	Jisiksanupsa
Mun, Mubyung	2005	The festival of the wind: Chilmuridang Yeongdeungguk	Whangkumal Press
Lee, Jiyoung	2003	The myth story of Korea	Sagoonja
Jung, Insub	2007	The tale of Korea	Dankook University Press
Jin, Sungki	2001	A myth and the legend which is sweeter than Greek mythology	The Institute of Cheju Customs
Hyun, Yongjoon	1980	The dictionary of shamanism	Singumunwhasa
The academy of Korean studies digital library http://www.lib.aks.ac.kr			
The encyclopedia of local Korean culture http://www.grandculture.net			

2.2.2 Development of storytelling learning materials

The development of the storytelling learning materials for this research proceeded as follows.

First, we extracted materials and developed the subject matter and the learning situation in a way designed to connect learners and trigger their motivation.

Second, the content of the learning was presented in the form of a narration which learners found easily approachable.

Third, the narrative form was described in a way that allowed learners to reconstruct the creativity and imaginative power of the stories.

Fourth, the learning process was structured so that individual study and co-learning could occur together.

Fifth, the materials were organized so that thinking power and methods of inquiry extended into problem solving within the structure of the stories.

The learning of narratives based on the structure of a story is important for a student's meaning formation and diversifies the capability of cognition student through imaginative power and analytic reconfiguration. Therefore, in this research, storytelling was introduced and the main direction of the teaching-learning process was arranged so that the development of materials and the teaching strategy selection which comprised and was suitable for it could be made.

2.2.3 Expert evaluations and subsequent modifications

The materials that we developed were evaluated by science education experts including two middle school science teachers. These experts gave us their opinions on whether the materials were comprehensible to learners and whether the contents of the program were connected with relevant learning topics or not. They also offered their ideas about effective ways of triggering motivation. We used the feedback from these experts when preparing the final version of the learning materials used in this study.

2.3 Application

The developed storytelling learning program was applied to four 9th grade students: two male students—K(m) and Y(m)—and two female students—L(f) and K(f). K(m) generally showed great interest in science and had attended lectures at a scientific gifted center attached to a university.

Y(m) was a very active student with average grades in science. L(f) also had average grades in science class; she was usually composed and calm and was known as a talented writer. K(f) had excellent science grades and strongly disliked writing. The subjects were all students of the middle school teachers who participated in this study.

Statistical processing based on a large-scale application of the program was not executed. We used observations and interviews to gather data on the various situations in which the participating students were involved in the process of completing the learning materials for narratives.

During interviews with a researcher, the four students presented their thoughts about how difficult they found the process of solving the given learning program.

The list of storytelling resource materials was given to students as they proceeded with completing the writing through the internet search. Mutual discussion was allowed. Participants met with a researcher three times prior to the application phase to establish the rapport required for the observation and interview sessions. After the dialogue while these students complete story data was analyzed and the learning was terminated, interview data about the thinking of a learner and feeling were executed.

3. RESULTS AND DISCUSSION

3.1 Learning content analysis and story line configuration

We analyzed the content of the 7th–9th grade science course of study based on the revision curriculum [19]. We analyzed the workbook content for each grade in terms of the contents of units and also in terms of how the contents of units were connected with preceding and subsequent lessons. We were therefore able to understand how the unit content corresponding to each grade level organically comprised the basic materials of the workbook content that was included in the learning program

We wanted to emphasize learning content that minimized duplication of content in the revision curriculum [19] while at the same time organically teaching related science concepts. Therefore, in the storytelling learning program configuration,

we emphasized the organic link between the storytelling content and the workbook content.

Particularly, in the story line configuration process, the framework of the storytelling learning program was designed through the exchange of opinions between the experts and a researcher. During this process, the teachers stated their opinion that presenting the entire content of the myths could impede the imaginative power of the students. The concrete content was therefore adjusted so that complete myths were not presented as part of the learning program and, instead, the goddesses described below were presented as central characters.

The Jeju Island myths are unique among the myths and legends of many regions in Korea, in that they center in particular on four goddesses who have been credited with managing all phenomena of nature including birth, the sea, wind, farming, and so forth.

These four mythic goddesses are Sulmundae, Yeongdeung, Samsin, and Jachungbee. Sulmundae is the goddess who, according to a myth of giants, created Jeju Island. Various stories, including that of the footprint of Sulmundae, are connected to many topographic features of Jeju Island. Yeongdeung is the goddess of the sea and wind who characterizes Jeju Island, which is known as "the island of the wind." Jachungbee is the goddess of farming, and Samsin is the goddess who is involved in production of a descendant in myth.

We determined that these goddesses related closely to the various phenomena of the natural world, which is the research object of science, and that there would be many possible ways of using these goddesses in science storytelling content.

3.2 Modification into pedagogical content knowledge

3.2.1 Design of the description method

In developing storytelling science learning materials for middle school students, we emphasized, in this study, the process of inquiry that is characteristic of the study of science, and we tried to utilize quest storytelling as part of the storytelling technique. In quest storytelling, learning takes place when the learner solves a conflict that has been created by presentation of an internal or external obstacle. That is, the kernel of quest storytelling is the educational process rather than the educational intention of specific content [3]. The content has to be detailed and the actual subject has to be established. The introduction of an event to create interest and a goal is called the obstacle presentation, and the goal is knowledge delivery. Therefore, in this research, the

presentation of quests to solve for each lesson involves the discovery of stories' contents in a form which a learner completes directly or which leads him or her to an answer.

Some scholars insisted on the effectiveness of freshly reevaluating a task through the excavation of storytelling materials [22]. The effect of storytelling can be maximized for middle school students when the excavated learning materials related to an object in the learning material development described below are associated with experiences in the everyday lives of the learners.

Because the myth of Jeju used in this research is related to various customs, topography, and so forth, it is content that learners can feel familiar with. Therefore, the students have experience with the use of the myth as a resource in the context of the community

Bruner asserted that the kernel of narrative thinking is the capability for plot composition and abductive thinking [2]. Particularly, there is an aspect of the plot composition process that can be linked with the abduction described by Peirce. Generally, abduction goes through the following steps.

- A. New fact C was seen.
- B. C is rightly a truth if the hypothesis A is a truth.
- C. Therefore, we have to verify whether the hypothesis A is a truth or not

Therefore, in this research, myth played the role of the new fact, or, in other words, the beginning of the process of abduction. Subsequently, learners completed a story by hypothesizing within the format of the plot composition and quest storytelling. An example of materials developed in this study is presented in Table 2.

3.2.2 Development of story and worksheet composition

Storytelling materials were connected in the large-scale story framework consisting of content that learners used to introduce the Jeju Island myth. This learning program was comprised of a form that introduced the goddesses as central characters of the Jeju Island myths to learners and that students used to solve a problem together and describe the process.

Each quest story was a separate story with a picture frame novel style, and all the stories had the myth of Jeju as a common point of reference. On the whole, the story configuration diagram was made in order to construct the system of the stories.

Table 2. An Example of Storytelling Material

<p>How does the Yeongdeung Halmang raise the wind?</p> <p>('halmang' means 'grandmother' in the Jeju Island dialect)</p> <p>Yeongdeung Halmang and her family begin to get busy as the second month of the lunar calendar approaches. Every year on February of the lunar calendar they go to Jeju Island, and sea foods such as brown seaweed and shellfish grow. For this reason, every year, the people of Jeju pray eagerly at an altar that they set up with great care, and the Yeongdeung Halmang comes to the Jeju sea. "Goddess, may you make our sea rich. May you blow the Yeongdeung wind."</p> <p>Every year about this time the Yeongdeung Halmang has to cause the big Yeongdeung wind, in order to head for Jeju Island.</p>

The story configuration diagram was made and the student activity connected with each story and which it presented was created. Two kinds of storytelling materials were developed for each of four myths, so a total of eight storytelling materials were made.

In the program development process, science education experts offered the opinion that, to complete the stories, the learners needed more detailed guidance on investigating necessary data or on conducting discussion sessions. Therefore, a list of students' participation activities including an investigation, discussion, announcement, and so forth was included in the worksheet.

3.3 Expert evaluations and subsequent modifications

Experts who examined the storytelling learning program developed in this study offered opinions about how to create interest in and trigger the motivation of the learners. Also, the teachers expected that the storytelling program would stimulate learners' narrative thinking in putting together the storytelling

materials. However, they said it was not clear how the program affected the learners' academic achievements in science. For this reason, they pointed out that it is necessary to systematically design scientific concepts so that the program could be applied to actual science classes.

Teachers gave the storytelling materials a positive evaluation. Particularly, they stated that the introduction of storytelling had meaningful results in science classes.

Teacher A: "I feel very unfamiliar with the connection between the unscientific legends and scientific principles. I am curious about whether students understand it. It seems to be a very new approach."

Teacher B: "It seems to be very meaningful to introduce a story in science class. But there are some students who feel very burdened when they are required to write a story. I think that we should consider whether students feel that this program makes science more difficult, or not."

Table 3. Contents of the Storytelling Learning Program

Contents of a myth	Grade	Unit	Contents of storytelling
Sulmundae: She is the giant goddess credited with creating Cheju Island. The various topographical features of Cheju Island are related to this giant myth, which has been handed down orally.	7	Force and motion	<ul style="list-style-type: none"> The story illustrates whether any kind of powers were used when making the varied topography of Cheju Island. This material includes how to calculate power needed to move an object, and what are the differences when tools such as a lever are used to move the same object. For example, did the Sulmundae goddess build the low flattish bridge over a brook and the large-scale puddle, or not?
		Material composition of and changes in the earth's crust	<ul style="list-style-type: none"> The story explains about the minerals comprising the earth's crust and rocks in connection with the volcanic activity that generated the formation of Cheju. This material includes a survey of rocks distributed across various parts of Korea, as well as characteristics of each region. By using the lava tunnel on Cheju Island, which is a UNESCO world heritage site, and Mulyoungari, which is the Ramsar bog on Cheju Island, this story introduces characteristic topographies.
Yeongdeung: She is the goddess associated with the custom in which, every year on February 1 of the lunar calendar, the Cheju people wish for the richness provided by the goddess of the sea and wind.	9	Characteristics of atmospherics and weather change	<ul style="list-style-type: none"> This story shows the principles of the wind that characterizes Cheju Island, the island of the wind. This material designs activities that are related to the principle of wind, air pressure, and how to read weather chart.
		The chemical composition and motion of sea water	<ul style="list-style-type: none"> This story illustrates the relation between the chemical composition of sea water and the motion of the sea water. In addition, a relation between the motion of the wind and seawater is shown.
Samsin: She is the goddess who takes care of all life. The exorcism praying to Samsin for pregnancy and birth is called Buldomagi.	7	The composition and diversity of organisms	<ul style="list-style-type: none"> The kinds and relations of the various creatures which are in an ecosystem are looked into through the role of Samsin. This material includes understanding of reproduction and generation.
	9	Heredity and evolution	<ul style="list-style-type: none"> Learners look into the features of life and think about the custom called Buldomagi, which addresses the dignity of life. This material includes a study of the law of Mendelian inheritance.
Jachungbee: Jachungbee is known as the goddess of farming. She brings many seeds from heaven, so that the Cheju people are able to have, each year, abundant farming.	7	Plant nutrients	<ul style="list-style-type: none"> Learners understand the sprouting conditions of seeds, based on the Jachungbee myth. This material includes conditions for germination and elements needed for plant growth.
	8	Human digestion, circulation, respiration, and excretion	<ul style="list-style-type: none"> Learners look into the nutrients contained in plants which the Jachungbee sends. They understand the processes used in the human body.

Particularly, science teachers made the point that teacher materials about the myth of Jeju needed to be provided to support teachers' implementation of the learning program. In addition, the idea was raised of developing story materials appropriate for learners at various levels within each grade. After considering these opinions we decided to develop teacher resources during this study and to develop materials for different levels in a subsequent study.

3. 4 The content of the storytelling learning program

Stories were analyzed to determine which story was most suitable to each topic and grade level. Each story was developed in a form in which an eventuality is not presented. Storytelling materials for eight units at the 7th-9th grade level were developed. A description of the content of the myths applied to the storytelling learning program in different learning units is presented in Table 3.

Because they were organized in the form of quest storytelling, each of the stories completed the process in which a learner solved a quest through storytelling. In those cases in which learners did not understand the content or found it difficult to concretely describe the content in completing a story, learners developed their knowledge through activities including the investigation of materials, discussion, experiment, and so forth. Therefore, the learning program developed in this study includes various learning activities that involve not only the understanding of content but also experimentation and the exchange of opinions with colleagues through discussion in the course of completing the quest storytelling, thereby providing many opportunities for teaching and learning. The research

results of a study [14] showed that there is an aspect of scientific activity that depends on narrative thinking over experimental observation. Discussion, semantic interpretation, and the process of mature consideration are essential in order to lead an observation and experimental result to a meaningful scientific outcome. Therefore, the positive contribution of this learning program is expected to be associated with the promotion of narrative thinking in the learners through various learning activities that go along with storytelling.

3. 5 Application and analysis

Students selected and completed four stories from among eight selections of story materials. They were able to utilize resource materials and discussion. The learning process was observed and recorded from the stage of wide distribution of the learning materials to the step in which students completed storytelling data.

When coming across storytelling data for the first time, learners seemed to feel very unfamiliar with the material.

- L(f): "What is this? Is it not learning related to science?"
- K(f): "It seems strange that the Sulmundae Halmang story is presented. What kind of correlation does it have with science?"
- Y(m): "don't have originally concern about a myth."
- K(m): "It has a try quickly. Only if one does that, whether it is any kind of word or not know."

Table 4. Example of a Story Completed by Students

How does a plant grow?	
<p>Jachungbee looked at her own garden and breathed out a sigh. Next spring, many crop seeds would be needed, to give to the Jeju people. But this year, many plants hadn't grown well, for whatever reason, and it did not seem easy to harvest the seed. When Jeju people ate the food in the field or went through a ceremony, they always devoted part of the food to Jachungbee while saying "Gosrae, Gosirae." Jachungbee always prepared abundant seed because she approved of the Cheju customs. So the Cheju people had always had years of abundance. But this year, the situation was not completely good and there was much worry. "Does it have to rain much? If not, is sunlight needed? So far, I have always cultivated many plants well; what is the problem this time?"</p>	
The story of Y(m)	The story of L(f)
<p>Jachungbee knew that sunlight was needed in order to germinate the seed. So she sent down stronger sunlight. And she eagerly sprinkled the water for the sprouting of the seeds on the field, because water is needed for sprouting. The right amounts of sunlight and moisture were given, and the seeds began to sprout.</p>	<p>Jachungbee thought with an anxious expression. The right amounts of sunlight and moisture were given and seeds began to sprout. And she felt with her hand whether the soil was too dry or not. And she prayed eagerly. "God of rain, please give rain to the soil on Jeju Island. It may help many things to grow, as the bad land is dampish." In answer to the prayer of Jachungbee, the black clouds came in crowds to the sky, and a raindrop began to drop. Then, Jachungbee spouted out with "whew," after breathing in. The cold air was warmed through the mouth of the achungbee. After a few days, green sprouts began to come out in the ground with one two, a new whole field was tinged in blue. The Jachungbee smiled delightedly.</p>

Learners were noisy for about 5 minutes and felt confused but then began to focus on the storytelling data. Learners did not fully utilize the investigation of materials in the process of working on the quest storytelling assignment. This can be interpreted to mean that developed storytelling materials are appropriate for learners at a certain level. Learners approached the process of completing the quest storytelling in a very serious manner. After about half an hour had passed, students had the following dialogue concerning their interpretations of the meaning of the data.

K(m): "Is the pulley the tool that can be used in material 1?"

L(f): "Do what you're thinking. There is no need for us to use the same answer."

K(f): "That's right. Is better than one known that the various stories are came out?"

K

(m): "But how does it evaluate if an answer is not one?"

K(f): "Well...I don't know."

Even when the various developments of stories showed possibilities for recognition, participants seemed to express their fixed ideas about the correct answers. This shows that learners' dominant experience with solving scientific problems has been with a process that focuses on finding the correct answers. Particularly, this kind of recognition shows that the learning opportunities afforded by development of content that students can understand, through the process of using a narrative to find the answers to scientific problems, has not been provided.

Measuring from the first introduction of materials, there was some difference in the time needed for story completion. Between 20 and 30 minutes were required, on average, to complete a story.

The interaction of the students increased in the process of making the final story.

K(f): "Do you know a kind of seed that Jachungbee brings?"

L(f): "Can we write down things which Jeju Island cultivates a lot of now?"

K(m): "I wonder the same thing. I'm thinking of things that grew traditionally."

Y(m): "If there was a similar myth in another area or country, is the seed that the goddess brings different?"

K(m): "Well..."

L(f): "Rightly, it asked."

Participants utilize creative thinking in the process of reading and composing a story [23]. Therefore, there is the possibility that storytelling science learning can have the positive effect of improving the creative problem-solving ability of learners. An example of a story completed by students is presented in Table 4. Participants made every effort to connect their stories, as shown in the examples in Table 3 and Table 4. Individual differentiation was apparent in the style of the completed stories, the discovery of content, and so forth. In addition,

misconceptions were expressed in the configuration of stories. This indicates that storytelling can confirm a misconception that exists in the narrative thinking process of a learner. Therefore, it is possible to look at expressions of misconceptions in storytelling in science learning. After all the participants completed stories, an interview took place in which all four participants were interviewed together.

K(m): "I wrote a composition thinking about the creation principle of the wind. But I found it difficult to write a story. What needs to be said? I felt awkward writing a story as part of science instruction."

L(f): "I found it difficult to write scientific content in a story. But it's really fun."

Y(m): "I wrote a story thinking of it as a scientific cartoon. I don't like writing compositions because then I have to think too much. Nevertheless, the myth story is interesting. And I thought about the myths of Greece that I had read before."

K(f): "I found it difficult to explain the scientific content using a story. But the story about many goddesses was interesting. When it seems like goddesses work on important tasks it feels good."

Participants showed by their reactions that they were excited about storytelling learning. This shows that storytelling science learning can possibly be used to increase interest in science education in Korea, which is confronted with a large-scale problem of degradation of interest in science. It is suggested that linking a wide range of research activities (e.g. investigation, debate) with the storytelling learning materials has a positive impact on improving the learners' academic achievements in science. Therefore, learning programs need to be continuously developed in order to raise interest in science learning.

4. CONCLUSIONS

Previous researchers [13], [24], [25] have insisted that, in the science education field, narrative thinking is needed to organize a connection between an activity and the meaning of scientific facts. Narrative thinking is closely related to scientific activity and scientific thought processes such as deduction.

However, traditionally, science is recognized as the product of the paradigm accident. In science education, this recognition acts as an element limiting the access that is provided by narrative thinking. Therefore, in this research, we developed a storytelling learning program based on narrative thinking, in order to raise interest in science and foster creative problem-solving abilities.

Storytelling based on the myths of a region can improve the learners' understanding of the workbook content. In addition, when students in Korea have difficulty recognizing science in science education, storytelling based on narrative

thinking should be attempted in order to improve students' understanding of science.

Quest storytelling comprises the basic system of the storytelling learning program developed in this study. Therefore, in this program, learners have to complete the presented quest story. In addition, since learners perform various activities including an investigation, discussion, and experiment in the process of completing a story, storytelling is interpreted from the viewpoint of teaching-learning strategies. When storytelling materials are introduced to the science class, learners contact the science learning content under various circumstances, and this enhances their understanding of the problem-solving process and also raises their understanding of, and their interest in, science.

It is important to begin by securing various narrative data in order to maximize the educational effect of the program. In addition, although the teaching-learning strategy is based on storytelling, the focusing effect of the program can be enhanced by a parallel use of materials that give visual impressions.

In the science education field in Korea, storytelling based on narrative thinking has still not been generally introduced. Therefore, the following notes anticipate the introduction of storytelling programs into science classes.

First, for storytelling to show an effect in the science class, it is important that the presentation of the story is not fragmentary and that the whole flow of the program builds one story structure. Therefore, the reconfiguration of the teaching content should be presented in such a way that teachers can utilize this type of learning program.

Second, preferably, various resources should be secured so that class can be actively engaged in the narrative. It is very important for a class to have access to materials that are suitable for the learner levels, concerns, synchronism, and so forth, so that the class utilizing storytelling can capture the interest of the learners.

Furthermore, efforts to share developed narrative materials and supplies in the field of education will be necessary.

A learning strategy based on narrative thinking is never an omnipotent trouble-solving broker for the science class. However, science classes that emphasize the use of narratives as an alternative to existing science education in which learning is dominated by a one-sided point of view about scientific knowledge is expected to convey the implication.

Research into the possible ways in which teaching-learning strategies based on narrative thinking can be applied to science education through developed storytelling learning programs, such as that described in this study, needs to be continuously conducted in the future.

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