

A Study on the Wetland Education in Elementary School Curriculum

초등학교 교육과정에서의 습지교육 방안

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Abstract: The ongoing climate crisis has led to greater recognition of the value of the numerous ecosystem services provided by wetlands, and the economic value of wetlands is increasing accordingly. As awareness of the value of wetlands increases, the need for wetland education in elementary schools is also increasing. Due to the nature of environmental education in elementary schools, where a distributed approach is taken, the systemic links between each subject must be further strengthened.

Therefore, the purpose of this study is to devise a wetland education plan. Currently, wetland education is mainly conducted through experiential programs, and most of these are one-off programs that are separated from the curriculum. Therefore, in order to increase the connection between wetland education and the curriculum, we analyzed the science textbooks and guidebooks used for grades 3-6 of elementary school and determined which elements of these books were related to wetland education. Based on this analysis, we devised an educational program to raise awareness of the ecological, cultural and economic value of wetlands, and to encourage students to use and experience the wetlands of the local community.

Three actions need to be taken to promote wetland education. First, in order to recognize the value and importance of wetlands and to conserve them, wetland education should be included within the curriculum. Second, the curriculum needs to be reorganized to encourage students to understand and experience wetlands. Third, each school must be urged to pay attention to wetland experiences and education and to provide support so that the educational effect is increased.

If wetland education in elementary schools is promoted, it will become possible for students to gain a sense of the importance and value of wetlands through direct and indirect experiences and explorations that are based on the correct perception of wetlands. Furthermore, it will be possible to practice the conservation of wetlands and wetland ecosystems. These programs are intended to contribute to vitalizing wetland education in the elementary school curriculum.

Key Words: Net Carbon, Wetland Protection, Environmental Education, Elementary School Students

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요약: 최근 기후 위기 상황 등을 겪으며 습지가 수행하는 수많은 생태계 서비스 가치가 인식되고, 습지의 경제적 가치 평가도 따라서 증가하고 있다. 습지의 가치에 대한 인식이 증대됨에 따라 초등학교에서의 습지 교육에 대한 필요성 또한 높아지고 있다. 분산적 접근이 이루어지고 있는 초등학교에서의 환경교육의 특성상, 각 교과간의 연계성과 체계성을 더욱 강화해야 하며 이를 위해 교육과정 재구성을 기반으로 하는 교육 프로그램이 필요하다.

따라서 이 연구는 습지교육 방안의 강구를 목적으로 한다. 현 습지교육은 체험 프로그램 중심으로 운영되고 있으며, 교육과정과 분절된 일회성 프로그램이 대다수이다. 따라서 습지교육과 교육과정과의 연계성을 높이기 위해 초등학교 3~6학년 과학 국정교과서 및 지도서를 분석하여 습지교육에 습지교육 관련 요소를 도출하였다. 이를 토대로 습지의 생태적, 문화적, 경제적 가치에 대해 인식을 높이고 동시에 지역 사회의 습지를 활용하고 체험할 수 있는 교육 프로그램을 개발하였다. 초등학교 4학년 학생을 대상으로 한 8차시 분량의 습지교육 프로그램을 고안하였으며 습지교육을 활성화하기 위해서는 첫째, 습지의 가치와 중요성에 대해 인식하고 습지를 보전하기 위해서는 교육과정 내에서 습지교육이 이루어져야 한다. 둘째, 습지에 대한 이해 및 체험을 위한 교육과정 재구성이 이루어져야 한다. 셋째, 교육 효과를 높이기 위한 습지 체험 교육이 이루어질 수 있도록 각 학교에서의 관심과 지원이 촉구된다. 초등학교에서의 습지교육이 활성화된다면 습지에 대한 올바른 인식을 토대로 직·간접적인 경험과 탐구를 통해 습지의 중요성과 가치에 대해 느낄 수 있으며 더 나아가 습지와 습지의 생태계에 대한 보전을 실천할 수 있을 것이다. 이러한 프로그램을 통해 초등학교 교육과정에서의 습지교육을 활성화하는 데 기여하고자 하였다.

핵심주제어: 탄소중립, 습지 보전, 습지 교육, 초등교육과정

I. Introduction

A wetland is a repository of biodiversity, a habitat for animals, plants, microorganisms, etc., and has a very high environmental, social, cultural, and economic value, such as purification of pollutants, flood control, climate mitigation, leisure, and aesthetic functions (Nam et al., 2021). The recent climate crisis has recognized the value of numerous ecosystem services that wetlands perform, and the economic value assessment of wetlands is increasing accordingly (Raven, Berg Johnson, 2001). In the study on the fixation of carbon dioxide to wetlands (Joosten et al., 2016), wetlands have been studied to show ecological importance by trying to estimate the value of wetland conservation areas by storing carbon dioxide through the process of reducing plant production (Choi et al., 2021). As a result of a survey conducted by the Ministry of Environment and the National Wetland

Center of the National Academy of Environmental Sciences for a total of 1,408 wetlands out of 2,499 wetlands for three years from 2016 to 2018, it was confirmed that 74 were lost and 91 areas decreased. In addition, over the past 100 years, 60% of the world's wetlands have been destroyed, and large areas of natural wetlands have been converted to other land uses such as urban areas and agricultural land. As a result, the amount of carbon in the atmosphere that can be absorbed by the wetlands is reduced, and the carbon absorption capacity of the global terrestrial ecosystem has decreased (Kim, 2020).

According to Yang and Kim (2010), a lot of research has been done on wetlands as wetlands are recognized as important ecosystems, but they do not even know the terminology of wetlands, do not even know the terms of wetlands, or have a negative prejudice that water is rotten or unnecessary. Most of them are children. Therefore, basic education on wetlands needs to be organized in the regular school curriculum, and teachers should have proper knowledge and interest in wetlands. However, there is hardly any mention of wetlands in the elementary school curriculum. Although the science course deals with the creatures living in wetlands, neither the economic and cultural values of wetlands nor the definition or concept of wetlands are introduced.

According to the research results of Park et al. (2020), on the perception of infants and elementary school teachers about the wetland experience program, the educational effect of the wetland experience education program is the change in the attitude to practice conservation of the ecosystem, environmental protection, and the effect on respect for life. In addition, in the study of elementary school students' perception change through wetland ecology experiential

learning by Kim and Hong (2010), the experimental group was divided into a non-experimental group and an experimental group and conducted theoretical classes and experiential learning, respectively. All of them improved significantly, indicating that the class based on experiential learning has more influence on the perception of wetlands. However, considering the various circumstances of schools, wetland experiential learning is often pushed out of priority.

Therefore, this study aims to find ways to recognize wetlands correctly in elementary school curriculum, to feel the importance and value of wetlands through direct and indirect experiences and exploration, and to practice conservation of wetlands and wetlands ecosystems.

2. Research Material and Research Problems

Compared to the increasing trend in the value evaluation of wetlands, the proportion covered in the current curriculum is not high. Therefore, in order to increase the understanding of the importance and value of wetlands and wetland ecosystems, it is necessary to study ways to realize wetland education within the elementary school curriculum. The research questions to achieve the purpose of this study are as follows. First, the characteristics and current status of wetland education are identified through analysis of existing research on wetland education. Second, we analyze the units to which wetland education can be applied in elementary school science textbooks for grades 3-6. Third, based on the textbook analysis results, we devise a wetland education program that can be applied to the 4th grade level, which has the highest proportion of dealing with wetland ecosystems. Based on this study, it is thought that it will be possible to provide

information necessary for implementing wetland education in the future curriculum.

II. Theoretical Background

1. Wetland

1) Wetland Definition and Value

The dictionary definition of wetland is moist, moist land. In the Wetland Conservation Act, wetlands are defined as inland wetlands and coastal wetlands as areas where fresh water, brackish water, or salt water permanently or temporarily covers the surface. An inland wetland refers to an area such as a lake or an estuary within a land or island. Here, the coastal wetland refers to the area from the boundary line where the water level line and the ground contact at high tide to the boundary line where the water level line and the ground contact at low tide. According to the Ramsar Convention, wetlands, whether natural or artificial, permanent or temporary, still or flowing, fresh, brackish or salt water, include swamps, peatlands, and watered areas, including those not exceeding 6 m at low tide. refers to all

According to the Ramsar Convention, wetland values include flood control, groundwater maintenance, shoreline stabilization and storm protection, sediment and nutrient retention, climate change mitigation, water purification, biodiversity maintenance, wetland production, recreation and tourism, and cultural values. Also, Kusler et al. (1996) and USGS (1999) set the function according to the location of the wetland as follows.

〈Table1〉 Functions by location of wetlands

division	function
isolated wetlands	Habitat for waterfowl, inland and wetland wildlife habitat, flood control, sedimentation and nutrient control, landscape beauty
Reservoir Wetland	Isolated wetland function, removal of sediment and nutrients from influent, fish habitat
riverside wetland	Isolated wetland function, sediment control, dike stabilization, flood induction
Estuaries and coastal wetlands	Isolated wetland function, fish and shellfish habitat, nutrient source for marine fish, erosion protection
barrier island wetlands	Habitat of plants and animals growing on hills, protection of hinterland from high-energy waves, scenic beauty

2) The Need for Wetland Conservation

According to Kwon and Choi (2009), when annual precipitation decreases and drying continues due to warming, the wetland ecosystem changes to a terrestrial ecosystem. and species in need of protection will disappear. Therefore, measures are needed to respond to such changes. This is because the lives of most plants and animals living in wetlands are closely related to each other like a cogwheel, and are sensitive to changes in climate and environment, and the resulting chain ripple effect will be rapid and large (Kwon and Choi, 2009).

3) Wetlands and Carbon Neutrality

Recently, the Intergovernmental Panel on Climate Change (IPCC) released the ‘Global Warming 1.5℃ Special Report’. According to the report, in order to stabilize the temperature rise to the ‘1.5℃ warming level after the industrial revolution’, which is the target of suppressing temperature rise, it is necessary to reach ‘net carbon

emissions' by 2050 at the latest, and to cut global carbon emissions by half by 2030. (Shim et al., 2019). Carbon neutrality is about making net emissions 'zero' so that the concentration of carbon dioxide in the atmosphere does not increase due to human activities. If carbon dioxide is emitted into the atmosphere, it should be offset using forest sinks or carbon capture and storage technology (Lee, 2021).

Wetlands are major carbon reservoirs, contributing to climate change mitigation by trapping and sequestering carbon in the soil. However, anthropogenic activities such as drainage for agricultural use, removal of vegetation, and peat extraction can turn wetlands (particularly peatlands) into carbon sources. As a result of anthropogenic activities, carbon stored in peat beds and ground water is rapidly released into the atmosphere in the form of carbon dioxide or methane. Moreover, the increase in soil temperature, which may occur due to the removal of vegetation, increases the rate of carbon dioxide emission from the peat beds. If the temperature continues to increase as a result of climate change, the decomposition of organic matter stored in wetlands will increase, and as a result, wetlands will become an important carbon source (Kim, 2020).

2. Significance of Elementary Education and Environmental Education in Elementary School

1) Environmental Education in Elementary School

The theme of environment is a desperate problem that is required in the times, but in elementary education, 'environment' is not set as an independent subject, but is only partially mentioned in each curriculum, so it is mostly a fragmentary angle rather than a total and

concrete approach to elementary environmental education. Among environmental education, environmental education through school classes can have a wide impact on the fact that all students who attend school are required to receive education, and it is also important to educate in that the basic concept of environment and ecosystem is formed in elementary school courses (Chi, 2011).

Environmental education in elementary schools in Korea is conducted by a distributed approach, which means that environmental education should be conducted in accordance with the characteristics of each subject in all subjects. For this, the linkage and systematization between each subject should be further strengthened. However, there are many problems to be applied in actual field such as lack of longitudinal and horizontal linkage between the subject and the school year, and excessive emphasis or omission of specific areas and contents of environmental education (Choi et al., 2001; Choi, Min and Choi, 2005).

2) Purpose of Environmental Education

Educational approach was mentioned as important for fundamental prevention and solution of environmental problems, and the 'Environmentally Sound and Sustainable Development' (E) discussed at the UN Environmental Development Conference (UNCED) in 1992 through the International Declaration of Human Environment in 72, the Charter of Belgrade in 75, and intergovernmental meetings on environmental education in Tbilisi in 77 SSD's emphasis has spread the awareness of the necessity of environmental education (Nam and Choi, 2007).

According to the report, environmental education allows humans to

understand the complex interrelationships between biological, geographical, economic and cultural elements, while at the same time acquiring knowledge, values, attitudes, and functions that can discover, solve environmental problems and manage the quality of the environment (UNESCO, 1980). The specific goals for achieving the purpose of environmental education were awareness, knowledge, attitude, function, and participation (UNESCO, 1980).

3) Significance of Educational Programs on Nature

The education program affects the change of students' perception and attitude, and especially the experience-based program increases interest due to the developmental stage of elementary school students. According to the survey conducted by Bang and Shin (2009) on 300 people who are interested in the general public and wetlands for the analysis of the public awareness of the conservation of wetlands in Korea, only 9.7% of the 300 respondents answered that the conservation of wetlands in Korea is well done, and it is necessary to improve the policies and systems related to the preservation of wetlands. On the other hand, 83.2% of the respondents said that it is important and 3% said that it is not important. In addition, 85% of the respondents said that wetlands should be protected even if they do not give direct economic benefits to humans. Through this, it can be seen that not only the stakeholders of wetlands but also the general public recognize wetlands as important natural assets.

In order to examine the effects of the wetland education program on the awareness and attitude of the students in urban elementary schools, the study (Choi, 2008) which conducted the post-test showed a significant difference in the function of the post-test of the control

group on the importance of wetlands, but there was no significant difference in the awareness and interest. Therefore, it was found that the wetland education activity program requires an educational activity program that students can experience directly rather than educational activities in the classroom.

III . Research Method and Procedure

In this study, the textbooks and guides of science state textbooks for the third and sixth graders of elementary schools were selected and analyzed. If the wetland education is conducted in the curriculum to raise the awareness of wetlands and to feel the value and necessity of them, the geography and biology are similar in the related disciplines, and there are many things that meet the achievement standards of science in the elementary school curriculum. Especially, the achievement standards of science and biology related units deal with the balance and maintenance of aquatic ecosystems, interaction between organisms and non-biologicals, and the necessity of ecosystem conservation, because it seems to be able to fully link with wetland education.

For this study, 18 papers were selected for analysis by searching for ‘wetland + education’, ‘wetland + value’, ‘wetland + environmental education’, ‘wetland + awareness’, ‘wetland + program’ in search tools such as DBPIA and RISS, and a theoretical basis was established by analyzing the national science textbooks and guidebooks of the 3rd and 6th grade of elementary school based on the 2015 revised curriculum. In addition, this study was conducted through the ADDIE

model (Ryu et al., 2013). ADDIE is the most generalized teaching model, consisting of analysis, design, development, implementation, and evaluation.

〈Table 2〉 The stages and activities of ADDIE model

Stages	Activities
Analysis(A)	The purpose of this study is to collect and analyze basic data for teaching design and to identify who and what to teach in what environment.
Design(D)	The specific teaching and learning goals and contents are selected, and the optimal teaching and learning methods and strategies are selected to achieve this. Also, an evaluation tool is designed to measure the learning results.
Development(D)	Based on the analysis and design, the data to be used in actual teaching and learning situations will be developed. The formation evaluation of the teaching and design process will be conducted to check whether effective, efficient, and attractive teaching design has been constructed.
Implementation(I)	The stage of actual application and operation of the developed teaching design process includes activities such as installation, use, maintenance, and management of teaching materials and strategies.
Evaluation(E)	The overall performance of teaching activities is evaluated. The teaching and learning activities are finally completed after evaluation.

* Source: Ryu et al. (2013), Educational methods and educational engineering

This study was conducted in the process of A-D-D-E except for the implementation stage. First, the existing research on wetland education and the textbooks and guides of science in the 3rd and 6th grades were analyzed. Based on the existing research on wetland education, this study tried to examine the wetland education plan that can be linked to the curriculum. Second, the grade of wetland education was selected and based on the achievement criteria, the foundation for the reconstruction of the curriculum was designed by expanding and linking to other subjects such as the original body, society, and Korean language. Third, the wetland education program for 4th grade elementary school students was developed and

evaluation criteria and methods were selected. At this time, the program was developed to meet the learning goals and achievement standards of the corresponding classes, and the flow of the wetland education program was naturally connected. Fourth, the feasibility of the developed wetland education program was reviewed by teachers and environmental education experts at the elementary school in the field, and the completeness of the wetland education program was improved based on feedback.

〈Table 3〉 Activity and contents by research stage

Stages	Activities	research contents
Analysis(A)	Analysis of the subjects of wetland education (elementary students), analysis of existing research, analysis of textbooks and guides	Analysis of Science Textbooks and Guidebooks in the 3rd and 6th Grades of Elementary School
Design(D)	Wetlands education program, topic selection, related books and learning materials, and wetland status	Selection of the grade for wetland education, analysis of related subjects and achievement standards, reconstruction of curriculum
Development(D)	Development, Evaluation Standards and Methods of Wetland Education Program	Development, Evaluation Standards and Methods of Wetland Education Program
Evaluation(E)	Expert review of developed programs and research results	Expert review and feedback on the validity of wetland education programs

IV. Research Result

1. The Present Status and Characteristics of Wetland Education

As the awareness of the value of wetlands increases, the awareness of the various ecological and environmental importance of wetlands

is expanding, and interest in conservation, restoration and efficient use of wetlands is increasing as an alternative to improve the water quality of rivers and lakes (Lee et al., 2010; Kong et al., 2014).

Wetlands also provide important opportunities for tourism and recreation, not only generating revenues from the tourism industry in the local community, but also creating educational value through tourism. The satisfaction survey of tourists who visited domestic wetland ecological tourist destinations showed that the factors of 'ecological value performance', 'educational value performance' and 'social relationship' had a lot of influences in the order (Bui, 2019).

Therefore, education programs are required to increase awareness of ecological, cultural and economic values of wetlands through wetland experience. It is necessary to find out the learner through literature survey, field trips, interviews, etc., and to set up the direction of wetland education by finding areas and contents elements that can be linked in elementary school curriculum.

〈Table 4〉 An analysis of the existing study on wetland education

subject	detail subject	research
wetland experience education	change of perception and attitude	Kim·Hong (2010), Son·Kim (2003), Nam·Son (2016), Park·Choi (2014), Son (2003)
	history	Yoon·Je·Jung (2006)
	program	Kang (2009), Moon·Choi·Joo·Joo·Lee·Choi et al. (2008), Shin (2015), Yang·Kim (2010), Lee·Lee·Min (2016), Jeong·Lee·Jung (2010), Hong·Choi(2011)
curriculum-linked education	adoption of regular subject	Park·Seo·Do (2020)
	textbook study	Heo·Lee (2008)
	environmental education model	Lee (2006)
	teacher recognition and training	Seo·Jung·Lee (2006), Sung·Park (2010)
	utilization plan search	Kwon·Kwon·Park (2016)

The results of analyzing the existing studies on wetland education showed that the most studies on wetland experience programs were followed by studies on the changes in students' perception and attitude after wetland experience education. As a result of wetland experience education, Park and Choi (2014) on students' awareness of wetlands concluded that the experience program using rice paddies ecosystem can have a positive effect on environmental sensitivity, which is the basis of practicing environmental problems (Park and Choi, 2014). In addition, as a result of wetland experience education, there were research results that could raise a positive perception of environment-friendly attitude and wetlands. Accordingly, Park, Seo and Do (2020) conducted a study to adopt regular subjects of wetland education, and it may be effective to decide and operate wetland education at a lower level rather than operating it as a regular curriculum of national unit. It includes the contents, so wetland education is possible even within the current curriculum (Park, Seo and Do, 2020).

The results of the analysis of the literatures are as follows: First, wetland education is operated mainly by experience programs. Considering the developmental characteristics and interest of students, the importance of field experience activities can not be overlooked, but there is room for discussion on the effectiveness of the one-time experience program divided from the curriculum. Second, there is a lack of connection with teacher training, teaching materials, and curriculum for wetland education. It seems that it is necessary to think about ways to improve the professionalism of teachers about wetland education and develop textbooks that match them or link wetland education in curriculum. Therefore, this study

analyzed the contents related to wetland education in elementary school science textbooks and developed a program based on the contents in order to make it possible to link the subject and wetland education within the curriculum, not the one-time experience education divided from the subject.

Also, the characteristics of current wetland education are as follows: First, it has the overall characteristics including understanding and experience of wetlands. Wetland education can cover various areas such as climate, ecosystem, habitat, water environment, and educational places can also be expanded to school outdoor environment, rice paddies, coastal and coastal wetlands including classrooms. Second, it has a relationship with affective domains such as environmental sensitivity and environment-friendly attitude. After wetland education, students have a positive perception of wetlands, which can be linked to the will to preserve wetlands.

Considering the current state and characteristics of wetland education, it is desirable that future wetland education should be done with connection with curriculum and curriculum. Park, Seo and Do (2020) said that wetland education and wetland research should be conducted in parallel with each other and effective wetland education can be carried out only with scientific information or knowledge supported (Park, Seo and Do, 2020). In the elementary school curriculum that pursues the harmony between life and learning, the learning effect will be further improved when the curriculum and wetland education are done together. In addition, wetland education should be integrated by approaching multidisciplinary and interdisciplinary. In order to explore the ecological, cultural, economic value of wetlands, wetland creatures, and the geographical characteristics of wetlands in our region in a

comprehensive and diverse way, it is necessary to reconstruct and approach various subjects in the curriculum. Finally, wetland education should include cognitive, definition, and behavioral areas. We should recognize and explore wetlands and wetlands, feel the value of wetlands through the process, and include the willingness and practice to preserve wetlands.

2. Textbook Analysis Result

Wetland education is not operated as a regular curriculum, and as a result of analyzing the 2015 revised elementary curriculum, no units or sanctions directly dealt with are revealed. The environment deals with integrated topics with strong interdisciplinary and multidisciplinary characteristics, but is a field of science that deals with the ecological connection between natural phenomena and organisms. The environment is based on scientific methods and thinking in the research subject and inquiry process, and it can be said that there is a deep similarity between the two subjects in terms of interdisciplinary theory and approach (Yoon and Nam, 2020) In order to learn using scientific methods and thinking-based inquiry methods under the theme of biological and ecological values inhabiting wetlands, the ecosystem area of the elementary curriculum and wetland education can be linked. Therefore, the results of analyzing the areas that can be used as wetland education for 3rd to 6th graders learning elementary school science subjects are as follows.

(Table 5) Analysis of the applicable units in elementary school science textbooks (3~6th grade) for wetland education

grade and semester	unit	learning subject	wetland education related element
3-1	3. life cycle of an animal	<ul style="list-style-type: none"> ※ Knowing the appearance and role of male and female animals ※ Raising Chinese cabbage white butterflies to understand the life cycle of Chinese cabbage white butterflies ※ Know the life cycle of various animals 	<ul style="list-style-type: none"> ◎ Knowing the Characteristics of Wetland Environments ◎ Know the age of an animal that lives in a wetland
3-2	2. animal life	<ul style="list-style-type: none"> ※ Knowing the characteristics of animals living in the ground, desert, water, and sky ※ Observing the appearance of animals and examining the appearance and movement of animals 	<ul style="list-style-type: none"> ◎ Know the characteristics of animals that live in wetlands ◎ Investigate and present an animal that lives in a wetland
4-1	3. life cycle of a plant	<ul style="list-style-type: none"> ※ Knowing the life cycle of a plant ※ Knowing the conditions a plant needs to grow ※ Observing the life cycle of a plant 	<ul style="list-style-type: none"> ◎ Know the life cycle of plants that live in wetlands ◎ Observing plants that live in wetlands
4-2	3. Life of plants	<ul style="list-style-type: none"> ※ Investigate plants that live in fields, mountains, rivers, ponds, and deserts and present their characteristics ※ Describe the characteristics of plants in relation to the environment in which they live 	<ul style="list-style-type: none"> ◎ Knowing the characteristics of plants in wetlands ◎ Knowing the Relationship between Wetland Environment and Wetland Plants
5-1	5. Various creatures and our life	<ul style="list-style-type: none"> ※ Observe and characterize fungi, protists, and bacteria ※ Knowing how fungi, protists and bacteria affect our lives ※ Learn how cutting-edge life science is being used in our lives 	<ul style="list-style-type: none"> ◎ Investigate the types of fungi that inhabit wetlands ◎ Know what wetland fungi do in ecosystems ◎ Investigate how advanced information and communication technology (ICT) can be used to protect wetlands

5-2	3. living things and environment	※ Knowing the meaning of ecosystems and classifying ecosystem components ※ Knowing the meaning of the food relationship and ecosystem equilibrium of living things that make up the ecosystem ※ Know the causes of environmental pollution and its effect on living things	◎ Examine the creatures that make up wetland ecosystems ◎ Investigating the factors that destroy or make wetlands disappear
6-1	4. plant structure	※ Observing Plant Cells Using a Microscope ※ Know the appearance and work of roots, stems, leaves, flowers, and fruits	◎ Collect plankton in water and observe it under a microscope ◎ Know the structure and function of plants inhabiting wetlands

3. Wetland Education Program Development

The purpose of this study was to develop an educational program to raise awareness of the ecological, cultural and economic values of wetlands and to utilize and experience wetlands in the community. The development criteria of educational programs are as follows.

First, the study developed the contents that can be directly investigated by students, increase their interest and interest, and experience by visiting them, and link the current curriculum with creative experience activities to enable them to learn about the current experience.

Second, the fourth grade science curriculum of elementary school revised in 2015 was analyzed focusing on textbooks and guide books, and the unit, materials and activities were reconstructed.

Third, through the participation in the program, the purpose of environmental education presented in the Tbilisi Charter was

composed so that the purpose of ‘awareness, knowledge, attitude, function, participation’ can be made in each session (UNESCO, 1977).

Fourth, the program was developed to expand knowledge by accepting the contents and opinions of other friends in the process of learning while self-directed learning.

As a result of analyzing the national science textbooks and guidebooks for the third and sixth graders in elementary school, the factors that can be linked to the fourth grade curriculum of elementary school and wetland education are as follows.

First, we learn the wetland plants among the wetland ecosystems by linking ‘one year of plants’ and ‘life of plants’. In the first semester of the fourth grade, the unit of ‘One Year of Plants’ and the second semester of the fourth grade, ‘Life of Plants’ were dealing with wetland environment and plants living in wetlands. Wetland plants account for a large portion of wetland ecosystems and are easy to connect with curriculums because of their high accessibility.

Second, the geography area of social studies and the area of wetlands exploration, investigation and visit are linked. The fourth grade social studies department of elementary school focuses on understanding the geographical environment of our area and understanding the characteristics of our area. At this time, we can learn about and investigate the wetlands of our area and make us interested in the wetlands of our area.

Third, the process of writing from the activity of finding and organizing information about wetlands to the writing of their thoughts about wetlands is linked to the writing area of Korean language. Based on the ability to utilize data and information in Korean language, it is possible to write and share information to people around them,

suggesting their opinions on conservation of wetlands, because it is appropriate for the composition of sentences. In addition, since the elementary school curriculum does not deal with the definition or scope of wetlands, it is possible to read books that provide information on wetlands using creative experiential activity time and learn about wetlands through expert cooperative learning model.

Therefore, the second session was linked to the second session in the first semester of the fourth grade science class, the second session in the second semester of the fourth grade science class, the second session in the creative experience activity, the first session in the fourth semester of the social studies class, the first session in the first semester of the social studies class, The first class of 'Yo' was planned for 8 wetland project classes, and the purpose of environmental education presented in the Tbilisi Charter (1997) was applied to each class. The themes by the next period are as follows.

A wetland education program was devised based on the components of wetland education by time. At this time, a seat majoring in environmental education with more than 10 years of experience. The responsible ethics-based stork story composition and the analysis framework of environmental education programs (Yoon and Nam, 2020) were used to verify the validity of five elementary school teachers in the doctoral program.

〈Table 6〉 List of components for each class of wetland education programs

sequence number	grade/ semester	subject	unit	theme	purpose of environmental education
1~2	4-1	creative experience activity	environmental education/reading education	Find out what wetlands are, and explore the role of wetlands as carbon dioxide reservoirs	recognition
3	4-1	society	2. location and characteristics of region	Look at maps of our area, look for wetlands in our area	knowledge
4	4-1	science	3. life cycle of a plant	Surveying the age of plants in our wetlands	knowledge
5	4-1	science	3. life cycle of a plant	Observing the wetland-inhabited plants in our area (field experience learning)	function participation
6	4-2	science	2. Life of plants	Exploring the characteristics of the plants surveyed, and knowing the characteristics of plants living in wetlands.	knowledge
7	4-2	science	2. Life of plants	Knowing the Relationship between Wetland Environment and Wetland Plants	knowledge
8	4-2	Korean language	5. Write a message that reveals your opinion	writing to present one's opinion on conservation of wetlands	attitude participation

V. Conclusion and Discussion

Based on the results of the study, the following discussions were made: First, in order to recognize the value and importance of

wetlands and to preserve wetlands, wetland education should be conducted within the curriculum. As wetlands are called 'natural kidneys', they not only act as huge filters through midnight action, but also have high social, cultural and economic values. As ecosystem damage and biodiversity decrease, the value of wetlands is becoming more important. Conservation and wise use of wetlands helps reduce the partial economic, social and ecological impacts that may result in climate change (Lee, 2006). In order to recognize the value of wetlands and the importance of conservation by students who grew up in cities due to the development-oriented modernization, it is necessary to understand and experience wetlands within the curriculum.

Second, the curriculum should be restructured for understanding and experiencing wetlands. For this purpose, this study analyzed the wetland ecosystem education plan that can be linked in the science curriculum of the 3rd to 6th grade elementary school. Especially, the developed program maintained the content level for understanding, experience and awareness enhancement considering the development level of the 4th grade elementary school students. It is expected that it will be effective in inducing and continuing students' interest by carrying out various activities such as direct experience, indirect experience, observation and classification in the program consisting of 8 sessions. Since the subjects of the 3rd and 6th grades are also covered with environment, ecosystem, environment and energy, it is expected that the range of wetland education will be expanded to the 3rd and 6th grade subjects.

Third, it is required to pay attention and support to each school so that wetland experience education can be done to enhance the educational effect. Observation, experience, expression and

communication play an important role in the curriculum due to the developmental characteristics of elementary school students. Visiting wetlands in our area to observe wetland creatures, and seeing and feeling how wetlands are being preserved is an area that can not be replaced by audiovisual materials or books. Therefore, support is needed in each school so that direct experience of wetland can be achieved.

In addition, this study has a limitation in that it studied the method of wetland education that can be done in elementary school curriculum, developed the program, and improved the validity through expert review, but it was not applied in actual school field. Therefore, it is necessary to apply the wetland education program within the curriculum and to reflux and supplement it.

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〈Appendix 6~13〉 A teaching plan for wetland education program

subject	Creative Experience Activities (secondary session)	
announcement of class	1~2/8	
unit	environmental education/reading education	
learning subject	Find out what wetlands are, and explore the role of wetlands as carbon dioxide reservoirs	
wetland related element	Definition of wetlands, range of wetlands, wetland ecosystems	
related achievement standard	—	
learning goal	You can read "Waterland is a breathable land" and explain the new information.	
class development	introduction and development	<ul style="list-style-type: none"> ● reminding previous learning <ul style="list-style-type: none"> · Read the 'wetland is a breathable land' using morning reading time ● motivation-induced <ul style="list-style-type: none"> · Announce what you have learned in 'Wetland is a breathable land' · Quiz for wetlands learned in books ● Learning 1: Becoming a wetland expert <ul style="list-style-type: none"> · Constructing a group of experts in learning by contention of 'welcome wetlands', 'wild wetlands', 'amazing wetlands', 'think wetlands', 'pleasant wetlands', 'guardian wetlands' · Set a task for yourself in a group · Reorganizing the group by task, exchanging questions with each other, and studying contents by table of contents ● Learning 2. Ask me anything <ul style="list-style-type: none"> · Go back to the original group and explain to the group friends within the task time (3 to 5 minutes).
	organize	<ul style="list-style-type: none"> ● The Contents of Learning <ul style="list-style-type: none"> · Select one of the six tables of contents, and organize the feelings in one sentence · Write a sentence on the honeycomb board, and attach it to the blackboard · Read what your friends wrote
evaluation plan	evaluation standard	<ul style="list-style-type: none"> · Did you read the book during reading time and know the contents enough? · Can you explain to your friends what you have studied in the content of the table of contents? · Can you summarize the contents of your study in one sentence?
	evaluation method	Observational Evaluation (Teacher)
	evaluation time	in class
	evaluation tool	learning paper, honeycomb board

subject	society	
announcement of class	3/8	
unit	1. Location and characteristics of the area;	
learning subject	Look at maps of our area, look for wetlands in our area	
wetland related element	The Type of Wetlands, the Range of Wetlands	
related achievement standard	[4society 01-02] Digital image maps are used to identify the location of major topographical features, and to learn the actual appearance of villages or faults through activities to reposition them on white maps.	
learning goal	You can look at maps of our area, and find wetlands in our area.	
class development	introduction	<ul style="list-style-type: none"> ● motivational induction • Google Earth, look for our region, our school, where I live through local textbooks ● Introduction of Learning Goals
	development	<ul style="list-style-type: none"> ● Learning1. Recalling experiences in wetlands • Announce the experience of seeing wetlands in our area • When we think of the topographical features of our region (coast, inland, etc.), we expect where the wetlands are likely to be located ● Learning 2. Finding wetlands in our area on a map • Finding wetlands in our area through Internet portal maps and local textbooks
	organize	<ul style="list-style-type: none"> ● Finding a way to the marsh around us • If you go on a tour of the marsh you have found, plan what route and what traffic you will choose to use
evaluation plan	evaluation standard	<ul style="list-style-type: none"> • Can we use the map to find wetlands in our area? • Can you figure out the route to our wetlands and plan your exploration?
	evaluation method	Observational Evaluation (Teacher)
	evaluation time	in class
	evaluation tool	textbooks, study papers

subject	science	
announcement of class	4/8	
unit	3. life cycle of a plant	
learning subject	Surveying the age of plants in our wetlands	
wetland related element	Wetland Plants, Characteristics of Wetlands	
related achievement standard	[4science 13-03] The process of one-year-olds of various plants is investigated to explain that the types of one-year-olds vary according to plants.	
learning goal	We can investigate the age of plants living in wetlands and wetlands in our area.	
class development	introduction	<ul style="list-style-type: none"> ● Introduction of motivation and learning goals Quiz: Where do these plants live? · Share your own experiences of wetlands
	development	<ul style="list-style-type: none"> ● Learning 1. Knowing the characteristics of wetlands · Learn about wetlands in our area ● Learning 2. Surveying the age of a plant inhabiting a wetland · Finding plants that live in wetlands in our area with smart devices · Select your favorite plants to investigate one year old
	organize	<ul style="list-style-type: none"> ● learning theorem · Arrange the research contents in the study paper · Share your research with your group of friends ● a notice of the next class · The plant surveyed will be observed in the second session · Think about the part you want to observe
evaluation plan	evaluation standard	<ul style="list-style-type: none"> · Do you know about the wetlands in our area? · Can you find wetland plants using smart devices? · Can you explain to your friends what you have investigated?
	evaluation method	mutual evaluation and self-evaluation
	evaluation time	during class, after class
	evaluation tool	study paper

subject	science	
announcement of class	5/8	
unit	3. life cycle of a plant	
learning subject	Plant observations in wetlands in our area	
wetland related element	Wetlands Plants, Habitats, and Wetlands	
related achievement standard	[4science 13-02] One-year-old plant can observe one-year-old plants by making observation plans and raising plants.	
learning goal	We can observe plants living in wetlands in our area.	
class development	introduction	<ul style="list-style-type: none"> ● reminding previous learning • Talking about the plant name you surveyed last time ● Introduction of Learning Goals
	development	<ul style="list-style-type: none"> ● Learning1. Planning observations • Know the location of plants to observe • Recording parts to be observed intensively ● Learning 2. Observing Plants • Go to the place where you have plants to observe and observe your appearance * Safety measures for risk factors and movement routes and safety precautions.
	organize	<ul style="list-style-type: none"> ● learning theorem • Recording observations in observational records
evaluation plan	evaluation standard	<ul style="list-style-type: none"> • Did you participate in observation activities in accordance with safety rules? • Did you observe according to the plan? • Did you record the observation in the observation record?
	evaluation method	Observational Evaluation (Teacher), Self-Evaluation
	evaluation time	during class, after class
	evaluation tool	observation record

subject	science	
announcement of class	6/8	
unit	1. Life of plants	
learning subject	Knowing the Characteristics of Plants in Wetlands	
wetland related element	Wetlands Plants, Wetlands Environments	
related achievement standard	[4science 05-01] Various plants can be observed and the plant can be classified according to the feature.	
learning goal	It is possible to know and explain the characteristics of plants living in wetlands.	
class development	introduction	<ul style="list-style-type: none"> ● motivational induction • See some of the plant paintings that my friend painted last time, and guess what plants are ● Introduction of Learning Goals
	development	<ul style="list-style-type: none"> ● Learning 1. To understand the characteristics of the observed plants (groups) • Making a group of students who have surveyed the same plants • Share the characteristics of the observed plants, and compare the characteristics I observed with the characteristics observed by friends. • Investigate whether there are other features that have not been observed using smart devices ● Learning 2. Knowing the characteristics of plants living in wetlands (all) • Presenting the characteristics of plants surveyed in each group
	organize	<ul style="list-style-type: none"> ● learning theorem • Listen to the announcements of friends, sort out the names and characteristics of plants living in wetlands • Set your own classification criteria and classify wetland plants
evaluation plan	evaluation standard	<ul style="list-style-type: none"> • Can you explain to your friends the characteristics of the plants you have observed? • Can you sort out the characteristics of plants living in wetlands after hearing the announcements of friends? • Can you classify wetland plants by your own classification criteria?
	evaluation method	mutual evaluation, self evaluation
	evaluation time	during class, after class
	evaluation tool	study paper

subject	science	
announcement of class	7/8	
unit	1. Life of plants	
learning subject	Knowing the Relationship between Wetland Environment and Wetland Plants	
wetland related element	Wetland conservation, biodiversity, ecological sensitivity	
related achievement standard	[4science 05-02] It can be explained that the appearance and lifestyle of plants are related to the environment.	
learning goal	The relation of the wetland plant and wetland environment is known. The resolution for protecting the wetland environment can be.	
class development	introduction	<ul style="list-style-type: none"> ● reminding previous learning • Talk about the classification criteria of wetland plants set by oneself and their classification accordingly ● Introduction of Learning Goals
	development	<ul style="list-style-type: none"> ● Learning 1. Knowing the relationship between wetland environment and plants • To learn about the characteristics of 'plants floating in water, plants living in water, and plants where leaves grow high on water' among classification criteria. • Discussing the relationship between the characteristics of each plant and the growing environment ● Learning 2. What if the wetland environment is destroyed? • Sharing experiences that have seen wetland environments contaminated or destroyed • Imagine and discuss what will happen to plants if the wetland environment is destroyed • Find out the appearance of plants in areas where actual wetlands have been destroyed (using photographs and video data)
	organize	<ul style="list-style-type: none"> ● learning theorem • Announce new information on the relationship between wetland environment and plants • Announce what I can do to protect the wetlands
evaluation plan	evaluation standard	<ul style="list-style-type: none"> • You can explain your thoughts on the relationship between the characteristics of plants and the growing environment. • You can imagine and say what can happen when the wetland environment is destroyed. • I can say what I can do to protect the wetlands.
	evaluation method	Observational evaluation (teacher), Interevaluation, Self-evaluation
	evaluation time	during class, after class
	evaluation tool	study paper

subject	Korean language	
announcement of class	8/8	
unit	5. Writing to reveal opinions	
learning subject	writing to present one's opinion	
wetland related element	Eco-sensitivity, Wetland Conservation Will	
related achievement standard	[4Korean language 03-03] Writes to reveal your opinion on a topic of interest.	
learning goal	You can write an article that presents your opinion to preserve the wetlands.	
class development	introduction	<ul style="list-style-type: none"> ● motivational induction • Introducing the Straw Attack Campaign • See a letter written by elementary school students to milk companies to convey their opinions, and then see what milk companies have done since ● Introduction of Learning Goals
	development	<ul style="list-style-type: none"> ● Learning 1. What opinions do you give to whom? • Recalling the destroyed wetlands we saw in the last car, think about what was wrong • Recalling what opinions to present to solve this problem • Think about who writing will be effective ● Learning 2. Writing to reveal my opinion • Based on the summarized contents, write an article suggesting my opinion to preserve wetlands • Writing considering the level and mood of the reader
	organize	<ul style="list-style-type: none"> ● learning theorem • Post your own writing on the (online) class homepage, and leave a comment on your friend's writing • Delivering an article to a person who wants to deliver
evaluation plan	evaluation standard	<ul style="list-style-type: none"> • Has your opinion and reason been revealed well? • Did you write in consideration of the level and mood of the reader? • Did you keep your Internet etiquette well when you left a comment on your friend's article?
	evaluation method	Observational evaluation (teacher), Interevaluation, Self-evaluation
	evaluation time	during class, after class
	evaluation tool	Korean Language Textbook (177 pages)

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