

Practical study on environmental education based on the concept of education for sustainable development (ESD) in a rural area of Zambia

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Abstract

“Education for sustainable development (ESD)” has been globally promoted with the rise of our concern of socio-ecological risk standing on the outcomes from United Nations Decade of ESD (UNDESD) from 2005 to 2014. The aim of ESD is to raise the good adults or citizens, who have the will, attitude and skills to contribute to build a sustainable society. On the basis of the idea of ESD and collaborating with teachers of three schools in a rural area of Zambia, we conduct our practical study on the development of site-specific environmental education program. It is the three-year research from FY 2013 to FY 2015 of Japan (April 2013-March 2015). Our research purpose is “What EE program would be possible and acceptable to the teachers of schools in a rural area of Zambia?” Then the research questions are “how to link the environmental elements of life in this area with learning activities in the EE program?” and “How does the developed EE program relates to the idea of ESD?” We developed the EE program with lesson plans focusing on water as well as its supplementary materials including environmental quality data (annual change in air temperature and water quality), the booklet entitled as “Story of Mukuyu”. In this paper, the structure of our developed environmental education program as well as its relation to the learning in the ESD are primarily described.

Key words : Education for sustainable development (ESD), Environmental education program, Water, Zambia

Introduction

“Education for sustainable development (ESD)” has been globally promoted and led by UNESCO with the rise of our concern of socio-ecological risk standing on the outcomes from United Nations Decade of ESD (UNDESD) from 2005 to 2014. Although the concept of ESD as well as its relation to environmental education would be still under discussion (Iyengar and Bajaji, 2011)¹, we define the ESD in general as the educational activity that aims at raising good adults or citizens who have the will, attitude and skills to

contribute to building a sustainable society. While the possibility of integrative implementation of environmental education and its challenges was discussed in the Sub-Saharan African region (Nampota, 2011)², in the current discussion on ESD, it is criticized strongly that the indigenous knowledge system is almost ignored in developing countries (Stephen, 2012)³. These strongly suggest the necessity of environmental education practice that emphasizes site-specific traditional/heritage knowledge produced in an everyday living practices with positing ESD as a comprehensive environmental education in which nature, society and

culture are integrated. The most crucial keyword is the “Relationship” in ESD. The relationship of people with physical and human environment supposed to dependent largely on the characteristics of site-specific natural, social and cultural context. In order to make the environmental education as part of ESD meaningful for students, the program should be developed with taking into account of site-specific context in which schools locate.

On the basis of the idea of ESD and of the development of site-specific environmental education program, collaborating with teachers of three schools in a rural area of Zambia, we conduct our practical study on the development of region-specific environmental education (EE) program. It is the three-year research from FY 2013 to FY 2015 of Japan (April 2013-March 2015). Our research purpose is “What EE program would be possible and acceptable to the teachers of schools in a rural area of Zambia?” Then the research questions are “how to link the environmental elements of life in this area with learning activities in the EE program?” and “How does the developed EE program relates to the idea of ESD?”

As the products of our research as answers to research questions, we developed national curriculum-based, community-based and at the same time user-friendly (applicable to everyday lesson) as the form of lesson plan booklet with some supplementary materials including some indigenous knowledge and environmental data.

Methodology

Target schools

All of our target schools locate in the rural area of Zambia, taking around two hours from Lusaka, the capital city of Zambia. Primarily the people are engaging in agricultural production, for example, maize, vegetables and keeping live stocks like cattle. Generally, they depend on a well, surface water like river or precipitation for their daily water use.

One of target schools is now in the state of transition from basic school to a combined primary and secondary school from grade 1 to grade 12. Another one was is community school from Grade 1 to 7. The other originally community school but is now primary school from Grade 1 to Grade 9. The first two schools are apart 2 km away and both are locating along the main road (unpaved) connecting the central town of

district with provincial capital city. But the third one locates apart from the main road, taking 20 or 30 min driving by car through a rough road.

We visited each school for 9 times (around 4 days/visit) from Nov. 2013 through Feb. 2016. In each visit, we observed their lessons including “Social development studies” and “Integrated science” and demonstrated our proposed model lessons, conducted the post-lesson discussion and workshop for feeding back our research outcomes to teachers in each school.

Approach to develop the program and its supplementary materials

Our approach could be divided into three components as follows;

Component One: In order to develop lesson plan booklet, four lessons was drafted, tested in three schools in our site with collaboration with teachers in those schools and revised based on the experiences and discussion with teachers. Finally, we developed four lessons. The topics of two out of four lessons are water and that of one is the use of thermometer. The other is observation of tree. These lessons are the core of environmental education program. In relation to the site-specific environmental context, we developed environmental education program by structuralizing the four lesson plans as a core, supplementary materials including the environmental data on air temperature and water quality as well as the booklet of “Story of Mukuyu” based on the environmental elements of our site.

Component Two: In order to develop the supplementary materials, data are collected on the changes in air temperature with a data logger as well as in water quality of well water with conventional test paper (Aqua-check, ECO, Siemens healthcare diagnostic co. ltd). The data logger (Small temperature recorder, “Ondo-tori”) is used to record electronically and automatically in every 20 min at each school (Inside the principal’s offices in the first two school and outside of school building in the third school) for 1 year from June 2014 to July 2017. The electronic data was processed by Excel. Water quality test was conducted in every three or four months in the same period for air temperature.

Component Three: In order to develop another supplementary material, the essays and drawings on wild fig tree (*Mukuyu in chitonga*) are collected from the grade 9 students of Nkonje primary school.

Results and Discussion

Component One-Lesson developed and implemented

As the biggest concern of teachers of three schools was revealed as water issue in our preliminary investigation on their environmental concerns in September 2012, we selected “Water” as the core theme of environmental education program. Additional findings in component One was that the lesson composition showed relatively high similarity in its pattern among teachers (Chikamori, et al., 2015, Akai, 2015)^{4, 5}. We developed the three text-book based lesson plans under the topics of “Water in daily life”, “Water cycle” and “How to measure a temperature” for Social and Development Studies (SDS) or Integrated Science (Integr.Sci) with different composition from that teachers in this area shared to widen their choices of lesson approach through demonstration primarily for G5 or G6 students because of language barrier and revised through discussion with teachers. In the development of lesson plans, we always were careful of introducing students’ daily life experiences, hands-on activities such as drawing and of promoting students’ active involvement in the lesson including question and answer, board work and the presentation of outcomes from their learning tasks in a classroom. Finally we developed the following four lessons and implemented in each school.

1-Water in daily Life

The aim of lesson is to raise students’ awareness of importance of water in a daily life as well as the work of drawing water and transportation water from water source to their homes. The primary activity is to draw the everyday use of water as well as to share their drawing with classmates by presentation or discussion.

2-Water Cycle-Evaporation and Condensation

The aim of lesson is to provide students with the understanding of precipitation (rain) based on the scientific concept of evaporation and condensation. The primary activity is question and answer using the charts and blackboard writing by a teacher. The additional focus of this lesson is to see students’ note-taking in English as an indicator of how they could follow what a teacher is teaching.

3-How to measure air temperature?

The aim of this lesson is to understand the way of measuring air temperature using a conventional

thermometer using a worksheet. The primary activity is provided to learn how to read the value of air temperature indicated by a thermometer. In relation to this lesson, we developed the mathematics lesson for processing of data of temperature using a worksheet.

4-How to observe a tree?

The aim of this lesson is to understand the way of observing tree systematically and scientifically using a worksheet. The story of Mukuyu tree developed in component-2 is the resource book for the study on the relationship between community people and tree.

Component Two-Development of supplementary materials

The booklet entitled as “Story of Mukuyu” was compiled based on the essay of grade 7 students of the third school to raise the awareness of site-specific traditional/heritage knowledge as well as of the relationship of them with nature. The booklet showed Mukuyu (in chitonga, the native language in our site), the wild fig tree and popular among Zambian people, has been used traditionally as the efficient indicator for the existence of good underground water resource as well as medicinal use of its leaf, and skin of trunk to treat a stomach pain, diarrhea, anemia and eye problem, and so on. Its contents are as follows;

Introduction

1. Observation of Mukuyu in the school yard
2. Traditional Heritage/Indigenous Knowledge of Mukuyu
 - 2.1 Medicinal and the other Use
 - 2.2 Water and Mukuyu
3. Learning activity around Mukuyu
 - 3.1 How to observe Mukuyu?
 - 3.2 Mukuyu-based Community learning

Component Three-Environmental data on the air temperature and water quality in our site

1-Air temperature: We recorded consecutively in three schools (two of them: inside of head teacher’s office, the other one: outside of school building) from June 2014 to July 2015 using a data logger. Figure One shows one of example of annual change in outside air temperature at the third school. All the data of are saved electronically in a flash memory for each school as one of supplementary materials. We hope these provides the basic data for the lesson of environmen-

tal education in our target schools.

2-Water quality: In every 3 or 4 months from June

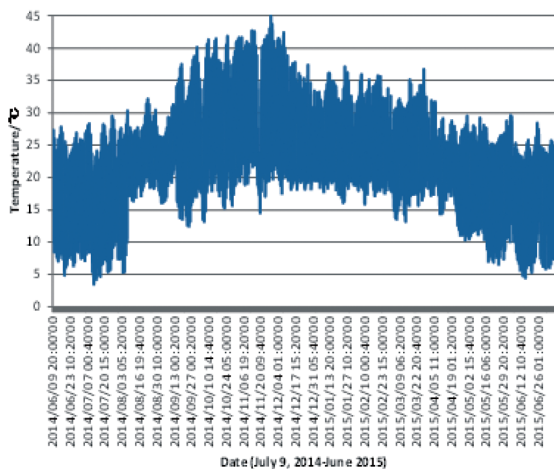


Figure One: Change in the air temperature of Our site (outside of the third school)

2014 to July 2015, we tested the water quality in terms of six indicators including the concentration of nitrate and nitrate nitrogen, total hardness as calcium carbonate content, total alkaline and pH using conventional test paper. Turbidity is evaluated by an eye observation, as shown in Table One. Each water samples were collected from the tap water of the site office of TICO (Tokushima International Cooperation Organization), our collaborating Japan NGO in our research, near the first school, from the bucket in front of head teacher’s office of the 2nd school, and from the well with hand pump in a school yard of third school. The data on water quality as one of supplementary materials is expected to provide the scientific basis not only in designing a new science lesson but also for providing basic data for the improvement of public health in terms of water quality in this site.

Linkage between results from components One, Two

Table One: Water quality of three schools

Sampling site	Month	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Total Hardness as Calcium Carbonate (mg/L)	Total alkaline (mg/L)	pH	Turbidity
The 1st school (Project site office of TICO)	June	1	0	120	180	7.2	Clear
	Sept.	1	0.15	120	120	7.5	Clear
	Nov.	1	0	120	120	7.2-7.5	Clear
	Feb. ²⁾	1	0	120	120	7.2-7.5	Clear
	July ²⁾	1	0	120	120	7.2~7.5	Clear
The 2nd School	June	1	0	0	20	6.8	Clear
	Sept.	0	0	50	40	6.4	Turbid
	Nov.	1	0	25	20	6.8	Highly turbid, (Salty)
	Feb. ²⁾	0	0	0-25	0-20	6.4	Turbid
	July ²⁾	0	0	250	120	7.2	Clear
The 3rd School	June	0	0	250	180	7.2	Clear
	Sept.	0	0	250-425	180<	7.8-8.4	Clear
	Nov.	0	0	250-425	180	7.5	Clear
	Feb. ²⁾	0	0	250	120-180	7.5	Clear
	July ²⁾	0	0	250-425	120	7.5-7.8	Clear

¹⁾ In June: From deep well in the school yard; ²⁾ 2015

and Three, and site-specific environmental context

We arrange our results from components One, Two and Three in relation to the life environmental elements to structuralize environmental education program focusing on water as its theme, as given in Figure Two.

Relationship between EE program and ESD

The environmental education program could be related to ESD by looking through the framework of

learning of “Four Pillars of Learning,” proposed by UNESCO (2015)⁶ since we think ESD is like the frame that could characterize the comprehensive approach of ESD to foster good adult or citizens. Each four pillars of learning are defined as follows;

- Learning to know: A broad knowledge with the opportunity to work in depth on a small number of subjects
- Learning to do: To acquire not only occupational skills but also for the competence to deal with many

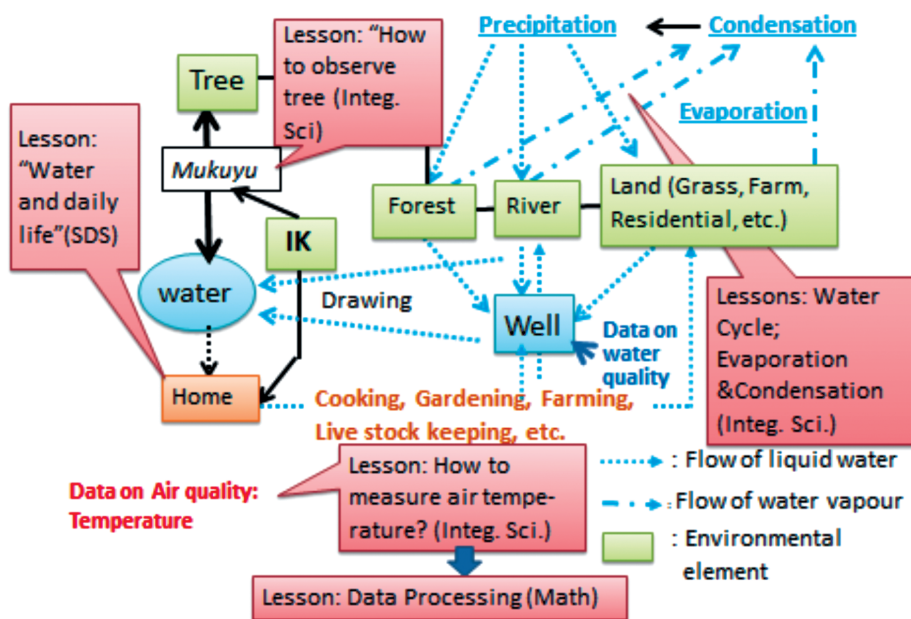


Figure Two:
Structure of environmental education program
IK:
Indigenous knowledge of Mukuyu

situations and to work in teams.

- Learning to be: To develop one's personality and to be able to act with growing autonomy, judgement and personal responsibility
- Learning to live together: By developing an understanding of other people and an appreciation of

inter-dependence.

Then the learning of students in our developed lesson is characterized from the perspective of ESD, as given in Table Two.

Generally, the primary focus of subject teaching and

Table Two: Characterization of the learning of students in our developed lesson from ESD perspective

Lesson	Four pillars of learning as a frame of ESD			
	Learning to know	Learning to do	Learning to be	Learning to live together
Water in daily life	-Importance of water because it is used in the various ways in a daily life	-Expressing his or her idea by drawing -Sharing his or her idea with others by presentation	-Responsibility for the family in his or her role of drawing water -Self-usefulness as a family member	-Importance and responsibility of them for water issues for his or her community
Water cycle- condensation and evaporation	-Basic and scientific mechanism of precipitation	-Thinking rain based on scientific concept	-Relationship between his or her daily life experience in terms of rain to the science of raining	-Raining and its impact to the life of people in community
How to measure an air temperature?	-Temperature can be measured by a thermometer	-Reading the temperature from a thermometer	-Relationship between his or her daily life experience in terms of change in environmental quality based on scientific data	-Change in an environmental quality and its impact to the life in community
How to observe tree?	-A tree can be characterized its shape in combination with the color, hand feeling and pattern of the bark	-Observing a tree systematically using senses of sight and touch	-Relationship and meaning of tree in his or her everyday life issues	-Importance and responsibility for tree issues for his or her community

learning is in the first two pillars, "Learning to know" and "Learning to do" to foster the knowledge and skill. But even in the science teaching and learning under the topics of water cycle, measurement of tempera-

ture and observation of tree, we could foster the sense of relationship of natural phenomenon (raining), object (tree) and quality of environment (air temperature) with students, its meaning or impact in his or her

personal (Learning to be) as well as in their community levels (Learning to live together), as indicated in Table Two.

Finally, we compiled the outcomes of all the research components and made the environmental education program booklet for the implementation of site-specific environmental education in future. Its contents are as follows;

Introduction

1. What is Education for sustainable development (ESD)?
 - 1.1 Concept of ESD
 - 1.2 Aim of ESD
 - 1.3 What consists of the “Frame” for ESD learning?
2. Planning of the lesson for environmental education program
 - 2.1 Concept of planning lesson
 - 2.2 Activity in lesson
 - 2.3 Composition of lesson
 - 2.4 Resources for lesson
3. Lesson plans for environmental education for environmental program
 - 3.1 Outline of lesson plan
 - 3.2 Lesson plan
 - 3.2.1 Water in daily life
 - 3.2.2 Water cycle-evaporation and condensation
 - 3.2.3 How to measure air temperature?
 - 3.2.4 How to observe a tree
4. Structure of environmental education program and its relationship with ESD
 - 4.1 Structure of environmental education program
 - 4.2 The relationship of environmental education program with ESD

These products, “Lesson plan booklet” and “Story of Mukuyu Tree”, are linked to the archive of International Cooperation Center for Teacher Education and Training (INCET) (<http://incet.naruto-u.ac.jp/ja/archive>)

Conclusion

By designing the lessons based not only on textbook and national science or social and development studies curriculum but also on the site-specific environmental context, the lessons enabled us to reflect both the national curriculum intention and reality of

rural area of Zambia. In order to link the environmental elements and learning activities in a school, we structuralized the environmental elements of our site as the framework of water-centered environmental education program in association with environmental object and quality, and then posited our developed lessons in the framework according to their contents. Through linking the four pillars of learning, proposed by UNESCO (2015), with our developed environmental program, we developed EE program based on the concept of ESD.

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Note: This paper is prepared based not only on our presentation entitled as "Development of environmental education (EE) program in a rural area of Zambia based on the idea of Education for Sustainable Development (ESD)" in the 24th Annual Meeting of the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE 2016) (January 12-15, 2016 at Tshwane University of Technology, Pretoria, South Africa) and but also on the research completion report that we submitted to JSPS in May, 2016, District Education Board that governs the education in research site, Central Province, Zambia and our research collaborating schools in February. 2016.