

## Development of Curriculum for Education for Sustainable Development (ESD) – Environmental Education for Ghana

Education for Specialized Subject matter & field  
Natural Sciences Education, (Chemistry)  
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This study has focused on the development of a curriculum on soil for ESD by using simple, most available and inexpensive local material. The curriculum is applicable to high school and collegiate levels for schools in Ghana, since Ghana is basically an agricultural country.

To find out to what extent students are aware about environmental issues, a pre-test questionnaire was conducted among selected students in Ghana, Cambodia, Philippines, and Japan to find out their level of knowledge in environmental issues. The findings are below.

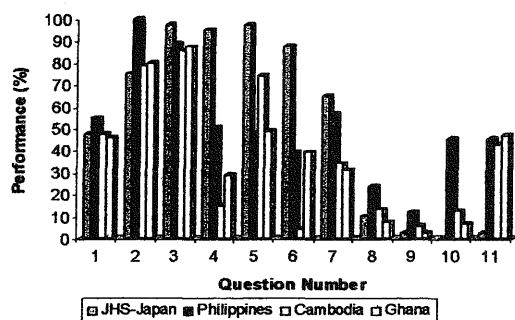


Fig. 1 Students' performance in pre-test

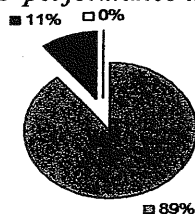


Fig. 2 Students' interest in environmental issues

Figure 1 shows that, most Ghanaian students did not do well in questions 4, 8, 9 and 10 which are related to acid rain, soil pollution, water contamination and environmental management.

It is imperative that in all the countries, students are very much aware and interested in environmental issues as shown in figure 2 but need to be exposed to topics relating to soil, water quality, environmental pollution and management in the form of activity-based classroom lessons.

Based on the above a comprehensive curricula unit on soil has been developed as shown in table 1. These activities have been tried at Johnan High and Amaki High Schools, both are Super Science High (SSH) school, in Japan.

Table 1 Main curriculum content

Sections	Topic/Activity
I <i>Physical aspect of soil</i>	Acid Rain: Origin and effects to the Environment Properties of soil; adsorption, ion-exchange, neutralization and water retention
	Soil Buffer and purification Capacities
II <i>Inorganic aspect of soil</i>	Measurement of elements in the soil ( $\text{Al}^{3+}$ & $\text{Fe}^{3+}$ ) Using 8-Quinolinol and 1,10 – phenanthroline as complexing ligands
III <i>Organic aspect of soil</i>	Soil & Humic substances: Organic matter in the soil, Properties of Humic Acids
	Extraction of humic acid from humus in black soil
IV <i>Biological aspect of soil</i>	Lets examine activities of micro-organisms in the soil

A lesson was held on the topic as an example: Activities of microorganisms in the soil with the main objectives of the lesson and students activities summarized in Table 2, and the apparatus used for this activity shown in Figure 3.

Table 2 Lesson plan on activities of microbes

i) **Main Objective**

Measure the presence of microorganisms in different solutions of soil using copy paper and hand made reflection photometer (CdS, LED)

ii) **Introduction:** (30min)

Students brainstorm on the following;

1. "What is soil?"
2. "What role does soil have in our daily life?"

iii) **Development:** (60min.)

Put all students into 10 groups provide an experimental guide and materials and students determine;

1. Demonstrate microbial activity on Copy Paper.
2. Demonstrate the principle of reflection meter apparatus.
3. Examine the reflection apparatus principle by using 0% - 100% blue copy paper.
4. Measure microbial activity in different soils.

iii) **Summary** (10min)

Students discuss microbial activities in soil and plot simple graphs with their results.

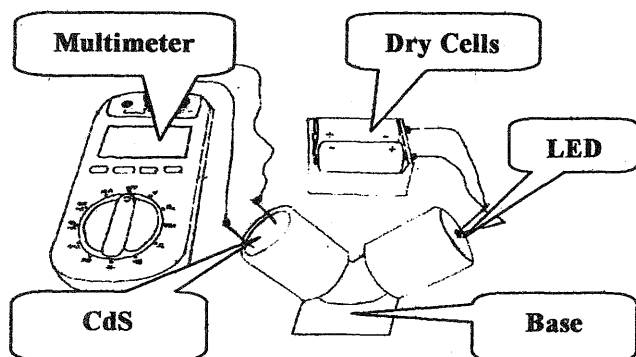


Fig 1 Main Experimental setup

The result of the qualitative analysis has indicated that copy paper which contains a lot of starch can be used to determine the amount of microbial activity in black soil.

**RESULTS AND DISCUSSION**

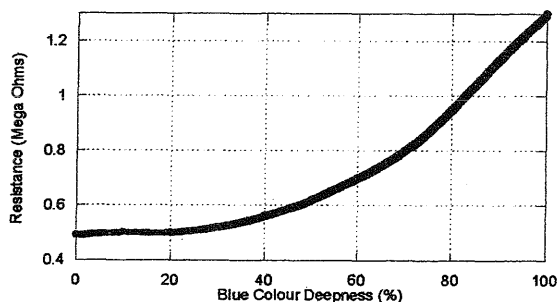


Fig 2 Resistance by Paper of diff. % blue color

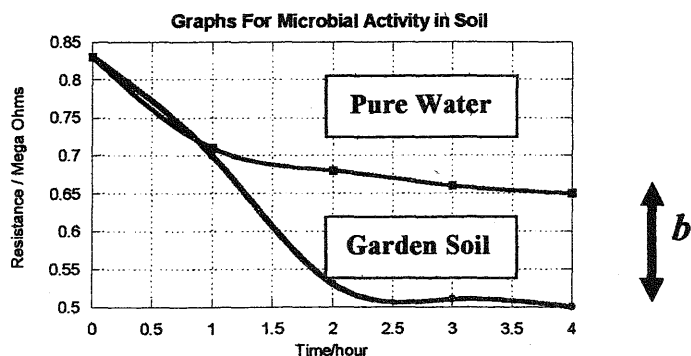


Fig 3 Resistance of Paper dipped in soil solution

$b$  = Microbial Activity in garden soil.

Results indicated that, resistance of light by CdS-LED reflection photometer increases as the % of blue colour also increases. The microbes in the soil solution consumed the starch in the copy paper hence its resistance decreases with time to a minimum value. The graph for water decreases with time since starch is soluble in water.

**The impact of whole unit on soil**

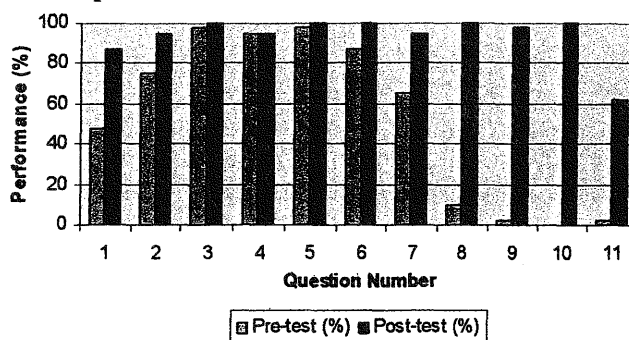


Fig. 3 Pre & post-test analysis at Johnan H. School

Paired-samples t-test was used to compare the means. There was a significant increase in the mean scores from pre-test ( $\bar{M} = 52.72$ ,  $SD = 41.63$ ) to post-test ( $\bar{M} = 93.83$ ,  $SD = 11.09$ ),  $t(10) = -3.502$ ,  $p(0.006) < .05$ . The Eta squared statistic (.41) indicating the lesson has much impact.

In conclusion, some recommendations have been made for improvement and implementation of ESD in the general curriculum of study in Ghana.