

ガーナと日本の基礎レベルにおけるエネルギー教育の比較研究

A comparative study on energy Education at the basic level between Ghana and Japan

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抄録：本研究はガーナと日本のエネルギー事情の違いを採り入れた研究授業を小学校と高校で実施し、エネルギー教育を国際的な視点から見直すことの重要性を実践的に明らかにしたものである。同時にガーナと日本の指導要領の比較をエネルギー教育の観点から行い、両国の今後のエネルギー教育への提案を模索した。

キーワード：エネルギー教育, ガーナと日本のエネルギー事情, 研究授業

Abstract : This study is concerned with: Comparison on Energy Education between Ghana and Japan and study lessons on energy from international view point.

Energy Education and issues in the two countries quite differ in several ways.

Findings of this research are as follows:

- i. In Ghana all the energy topics are taught under natural science but in Japan they are integrated with other subjects
- ii. In Ghana and in Japan it is part of the school curriculum furthermore in Japan some schools are sponsored by private companies in the energy sector as a project.
- iii. In Ghana energy lessons are started at grade 4 but in Japan, Tsunomine elementary, grades 1
- iv. In Ghana the lessons are more theoretical but in Japan they are practically oriented

Keywords : Energy Education, Energy situations of Ghana and Japan, study lesson

1. Introduction and background

The educational system in Ghana has undergone many transitions. Traditionally Ghana followed the British model of education but is now moving towards a system similar to that of the United States of America. A new elementary-secondary system has been established and at the higher level, a four-year bachelor's degree program has replaced the

three-year program of the former system. In addition, universities have switched to the semester, course-credit systems. This new system was introduced because it aims at making education more responsive to the nation's manpower needs, rather than purely academics (Anamoah-Mensah, 1998).

The state education administrative body of today is a large and increasingly decentralized structure. The Ministry of

Education is responsible for formulating educational policies, while the Ghana Education Service (GES) is responsible for its implementation at the pre-tertiary level, the National Council for Tertiary Education (NCTE), for implementation at the tertiary level and the Non-formal Education Division (NFED) for the implementation of non-formal education policy. The GES is represented in all the ten regions and in all 110 districts of Ghana.

The Education Reform Program launched in 1987 changed the structure of the former education system from the statutory 17 years of pre-tertiary schooling to 12 years. The current system of education reflects the changes brought about by the reforms.

Basic Education is the barest minimum of education that is the legally mandated right of every Ghanaian child. The basic education program is designed to cover the first nine years of schooling for each child. This basic education is not to train children for specific vocation or jobs. Instead, it is to give them exposure to a wide variety of ideas and skills and instill attitudes that will help them to cope creatively with their own environment and to be assets to their country.

The age at which formal education begins is 6 years, after attending 2 years of pre-school education. Currently, there is a 6-3-3-4 structure of education representing a 6-year primary, 3-year junior secondary, 3-year senior secondary and 4-year basic university course. The first 9 years, namely primary and junior secondary, form the Basic Education, which is free and compulsory. This structure is based on the policy of providing 9 years of basic education for every Ghanaian child. A national examination, Basic Education Certificate Examination (BECE) is conducted for all students completing the basic education. Those who pass this examination move on to the senior secondary school for three years. They also write another national examination, after which they enter any post-secondary institution (Benneh, 2001).

Similarly, the Japanese public Educational system is highly centralized and administered under the Board of Education. In some areas, high schools are under the direct authority of these boards, while elementary and junior high schools are managed by local (municipal) boards of education. For example, in Naruto, high schools are directed by the prefectural board of education but elementary and junior high schools are directed by the municipal board. In general, in rural areas, high schools will be managed directly by the prefectural board and elementary and junior high schools by the municipal board whereas in large urban centers, all schools are under the authority of one Board. Education is

compulsory for students from the age of 6 to 15 (i.e., for those at the elementary and junior high school levels). It is also tuition-free, although parents must provide required materials such as uniforms, math kits, and calligraphy sets. At the end of 3 years of junior high school, students must choose a high school they would like to enter and most will take a high school entrance exam. While nearly all Japanese children go on to high school, none are guaranteed admission. Students have several choices of high school. First, there are public, private, and a few nationally funded high schools. Within the public and private sector, students can apply to academic high schools or to non-academic high schools. About 25 percent of students eventually enter the non-academic track; though most originally hope to get into academic high schools. Those who fail to enter either a full-time public or private high school may attend night courses offered by some public schools. There are also correspondence courses and training schools open to students who fail to find a place elsewhere in the system (Miera, 1997).

The first post-war *Monbusho* curriculum in Japan was implemented in 1947 after the United States returned sovereign powers to Japan with the signing of the San Francisco Peace Treaty. This curriculum emphasized life experiences and practical knowledge. The second national curriculum, which was implemented in 1958, emphasized basic academic skills, particularly in arithmetic and Japanese. *Monbusho* continued the policy of higher academic standards with the third curriculum, published in 1968. This curriculum also reflected *Monbusho's* attempt to modernize the Japanese education system. As part of the modernization effort, *Monbusho* sought to integrate the junior high school and elementary school curricula more effectively and to improve the curricula in all subjects. Improvements in math and science education were integral parts of the modernization effort.

By the late 1970s, the Japanese Teachers' Union and others began expressing concern over what they called "educational overheating" (*kyoiku no kanetsuka*). According to these critics, Japanese students were studying excessively hard because of the increasing focus on entrance examinations and entrance into highly ranked colleges. In an effort to cool down the "educational overheating" and respond to these critics, *Monbusho* reduced the total number of class hours by 10 percent in the curriculum revision of the late 1970s.

Recently, some Japanese policy makers have expressed the opinion that curricular revisions should be more frequent in this age of rapid social change in Japan. In response to these

suggestions, *Monbusho* and its advisors are currently considering a revision period of 8 years. With the recent suggestions in parliament that, Basic education should be changed to 8 years elementary Education, and 4 years junior high as opposed to 9 years elementary and 3 years junior high school. (*Monbusho*, Ministry of Education, Science, Sports and Culture, 1994).

The current curricular guidelines in Japan were published as a set of proposed guidelines in 1988. Implementation has been in stages, with the elementary school curricular guidelines having been implemented in 1992. The new curriculum includes a reduction of emphasis on arithmetic and science in the early school grades. Since 1968, arithmetic has been reduced from about 19 percent to 17 percent of the sixth-grade total class hours. Likewise, science has been reduced from about 13 percent to 10 percent of total class hours. The new curriculum establishes more electives in junior high school. Overall, the new *Monbusho* curriculum mandates the following major changes:

- Comprehensive reform of moral instruction;
- Merging of science and social studies in the first and second grades into a new subject, the study of life activities;
- Increase in the range and number of electives in junior high school;
- Creation of two new subjects in high school (earth history and citizenry) by reorganizing the old social science subject, and
- Reforms in the treatment of the national flag and national anthem in school.

With the new curriculum, *Monbusho* states that it is seeking to cultivate students who are, in the words of one teacher, "creative, philosophical, able to make judgments and decisions and able to express themselves." These are the qualities that some reformers of Japanese education have said the *Monbusho* curriculum and Japanese schools did not emphasize in the past and that they hope can be cultivated among Japanese children currently in school. (Ministry of Education, Science, Sports and Culture, 1997). *Monbusho*. Japan.

In summary, the above efforts by *Monbusho* to reform and restructure the Japanese educational system to meet current demands for human resources which forms the basis for material development over the years has made it one of the outstanding and successful reforms in our part of the world. It is for these reasons that we tried to compare one aspect of the Japanese curricula, Energy Education which we found to be unique, to that of Ghanaian curricula so as to take some

lessons out of the Japanese experience.

2. Purpose of the this study

The main purposes of this study include.

- i) To Compare the Electric resources and consumption between Ghana and Japan by way of production by country as a whole and production per person
- ii) Comparison of Energy Education Curricula between Ghana and Japan by way of critically examining the curricula content of energy related topics for the two countries from elementary school to junior high school
- iii) Practical research by study lessons on Energy by comparing lesson preparation and presentation for the two countries and
- iv) To make suggestion to new Energy Education Curricula from international view point for the two countries

3. Research Methods

1. A comparison of the Curricula for the two countries.

The science syllabus for basic schools in Ghana was compared with the course of study for Japanese schools and the similarities and differences were noted for the purpose of the study.

2. Comparison on energy sources and production between Ghana and Japan.

The energy sources and production for the countries were compared and similarities and differences were drawn.

3. Lessons planning based on the energy sources and production for the two countries to Tsunomine elementary school, (*a special school investigating on energy education for three years*) Johnan high school, (a science model school) all in the Tokushima prefecture

4. a. Observation of a demonstration lesson on Energy Education, at Tsunomine Elementary School in the Tokushima prefecture by a Japanese teacher.

A lesson was observed at the Tsunomine elementary school on the 14TH of February, 2004 where pupils in grade three were taken through activities on energy sources and conservation. Toys and local materials were used to demonstrate how energy can be produced from various sources.

- b. Presentation of lesson on Energy sources and production in Ghana at the Tsunomine Elementary school.

A lesson was present at the Tsunomine elementary school on energy sources and production in Ghana with special emphasis on the two main dams in Ghana that

provides hydro-electricity.

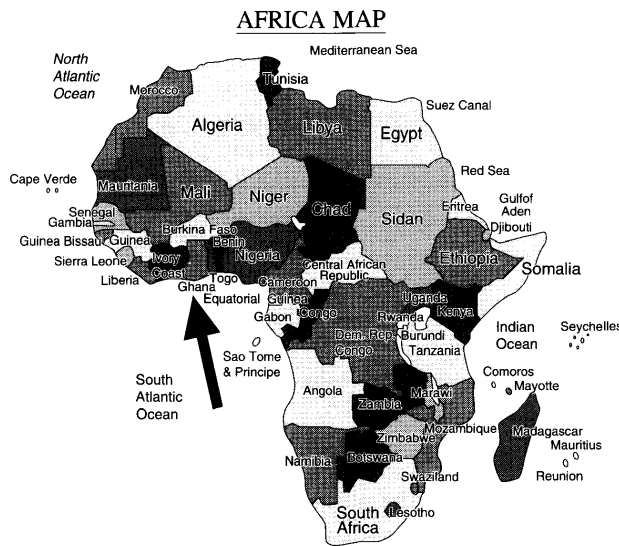
- c. Lesson presentation on Energy situations in Ghana at Johnan High School in the Tokushima prefecture. (a supper science school)

A similar lesson was presented at Johnan High School in the Tokushima prefecture on the 2nd of June 2004 at a super science school and the students responses were collected as a feed back for the lesson.

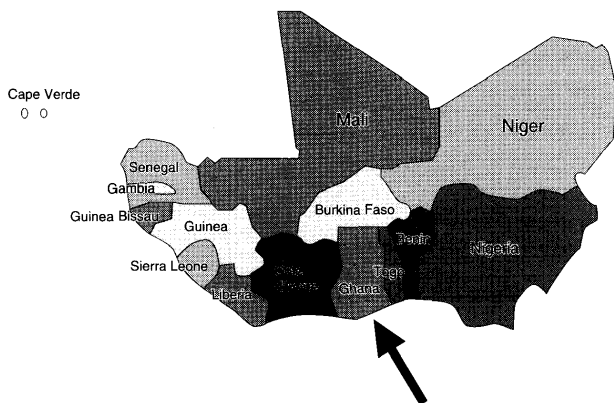
- 5. Find out suggestions for Energy Education

Based on the research findings, suggestions for energy education were made for both Ghana and Japan to be considered if possible for implementation.

- 4. Fundamental data and comparison on electricity between Ghana and Japan



WEST AFRICA MAP



1) ENERGY SOURCES IN GHANA

The Energy used in Ghana is obtained from three main sources thus, from wood fuels, i.e. firewood and charcoal, as indicated above.

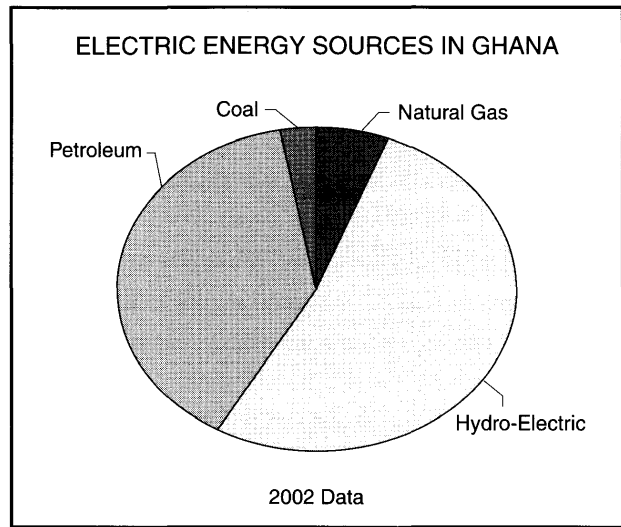
Wood fuels account for about 70 percent of total primary energy supply and about 60 percent of the final energy

demand, Petroleum 10%, and Hydroelectricity 20% with a Total of 100%

ELECTRIC ENERGY SOURCES IN GHANA

SOURCE	Production	
	PERCENTAGE (%)	ABSOLUTE (kWh)
Nuclear	0.00	0.0
Natural Gas	6.04	6.8 x10 ⁸
Hydro Electricity	54.00	61.0 x10 ⁸
Petroleum	36.96	41.8 x10 ⁸
Coal	3.00	3.4 x10 ⁸
Total	100.00	113.0 x10 ⁸

2002 Data



2002 Data

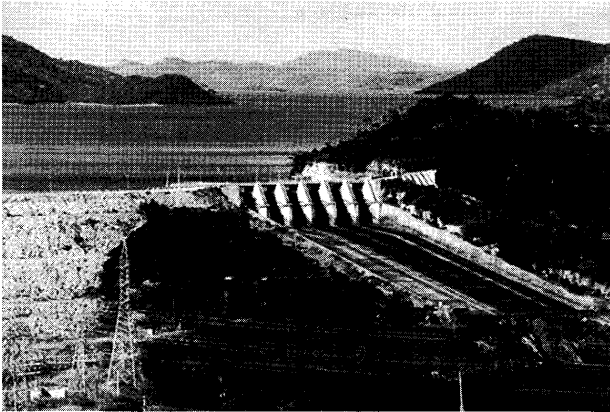
Ghana obtains its main Electricity from hydro generation basically from two dams built on river Volta currently called lake Volta. One of the dams is at Akosombo which is called the Akosombo Dam and the other is At Kpong which is called the Kpong dam. The two dams provide about 54% of the total electric current production.

The main producer of electric power in Ghana is the Volta River Authority (VRA), with six 127 MW turbine at Akosombo and a 160 MW turbine at Kpong on the downstream on the Volta Lake. The VRA is owned by the government of Ghana, but a Power Sector Reform Program initiated by the government is seeking to encourage independent power producers to pitch in Ghana and supply power hence the establishment of the Electricity Cooperation of Ghana (ECG). ECG is the sole agent who purchases and supplies electric power for domestic consumption.

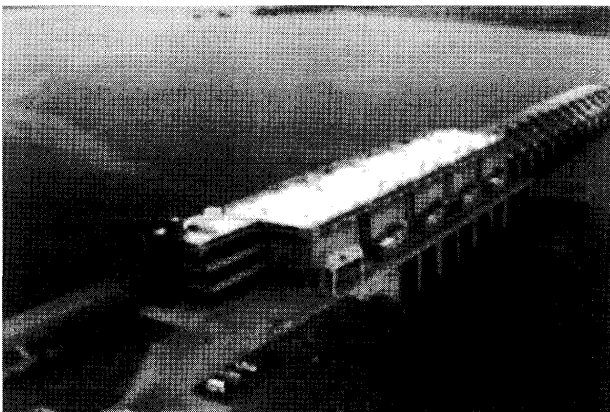
With lessons learnt from the over dependence on the hydro-generating sources, the government, within a short space of time, increased the reliance on other sources of energy. Two thermal plants have been commissioned to meet the escalating demand for energy. The first one, with a capacity

of 300 MW, built by the Ghana National Petroleum Corporation (GNPC) in the Western Region and the second one built by the VRA at Tema. These two plants use petroleum to generate electric energy which is the second largest electric energy producer for the country providing about 37% of the total electric energy production.

AKOSOMBO DAM (Aerial view)



THE KPONG HYDRO STATION (Aerial view)



Natural gas was first discovered in the Cape Three Points Basin in 1974. Ghana has total estimated natural gas reserves of 840 billion cubic feet (bcf). This gas is primarily located in the Tano fields. The Ghana National Petroleum Company (GNPC) has continued exploration and appraisal on the Tano fields, and has deemed that the natural gas reserves are suitable for electricity generation. Current Tano gas reserves are estimated to be sufficient to supply fuel to power a 100-140 megawatt (MW) power plant for a period of 15-20 years hence the establishment of The Tano Fields Development and Power Project (TFDPP) who are carrying out two types of gas explorations i.e. inshore and off-shore.

The offshore portion consist of the drilling of eight gas wells on the Tano fields, installation of platforms and process facilities, construction of pipelines and hydrocarbon-gathering systems and construction of an onshore production facility. GNPC also plans to maximize gas production at the Tano Fields Development and Power Project (TFDPP) by

utilizing horizontal drilling technology. Power will be generated by barge-mounted turbine generators fired by gas produced by gas. Initial capacity of 134 MW is planned, but if additional and sufficient gas reserves are discovered, another 134-MW barge will be constructed. Currently, this project provides about 6% of the country's total electric energy.

Coal is also used to generate electric energy on a small scale in the country as it is basically used by locomotive trains for transportation. Coal is not mined in Ghana but rather imported from South Africa by the Ghana Railway Authority (GRA) for private consumption only. This provides about 3% of the electric energy for the country.

On the other hand, Ghana has no electric energy from nuclear sources.

HYDRO-ELECTRICITY CONSUMPTION IN GHANA

• Volta Aluminum Company (VALCO)	19.0%
• Electricity Cooperation of Ghana	48.4%
• Togo & Benin (Export)	4.6%
• La Cote d'Ivoire (Export)	23.8%
• Others	4.2%

Hydro-electric produced in Ghana is basically distributed among five sectors which include Volta Aluminum Company (VALCO) Electricity Cooperation of Ghana (ECG), Togo and Benin, Ivory Coast and other

The largest consumer of electric energy in Ghana is the Electricity Company of Ghana (ECG) which is the sole agent that buys the power from VRA and redistributing it to private individuals and domestic use. This company consumes about 48% of the total production in the country. It is purely a private institution and owned by private individuals.

The second is VALCO which uses about 19% of the total electric production uses the energy to convert Bauxite which is mined in the country into pure Aluminum products such as roofing sheets, cooking utensils etc. this company is also a private company with the Ghana government owing about 30% share.

The third is export to Togo and Benin which are neighboring countries to the east of Ghana about 5% and also export to Ivory Coast which is to the western part of Ghana about 24%.

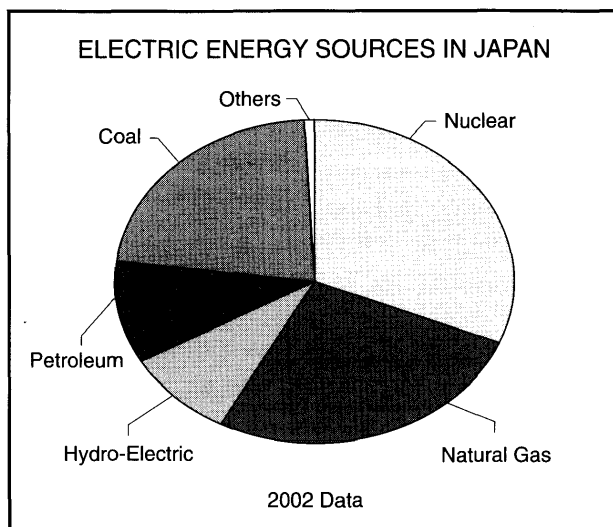
Other sectors which include; mining, Agriculture, textile industries also sometimes buys directly from VRA which accounted for the remaining 4% of the total production.

2) ELECTRIC ENERGY SOURCES IN JAPAN

Similarly, Electric energy production in Japan includes the followings;

SOURCE	Production	
	PERCENTAGE (%)	ABSOLUTE (kWh)
Nuclear	31.20	2950 x10 ⁸
Natural Gas	26.60	2510 x10 ⁸
Hydro Electricity	9.00	850 x10 ⁸
Petroleum	10.20	960 x10 ⁸
Coal	22.20	2100 x10 ⁸
Others	0.80	80 x10 ⁸
Total	100.00	9450 x10 ⁸

2002 Data



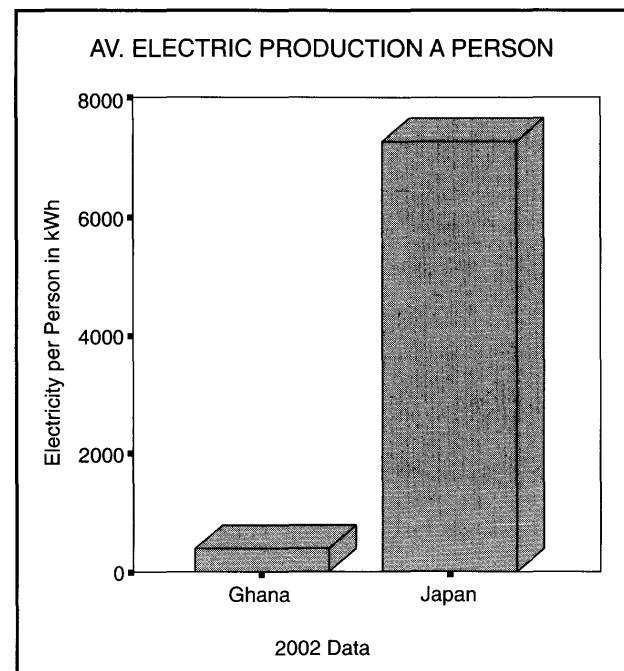
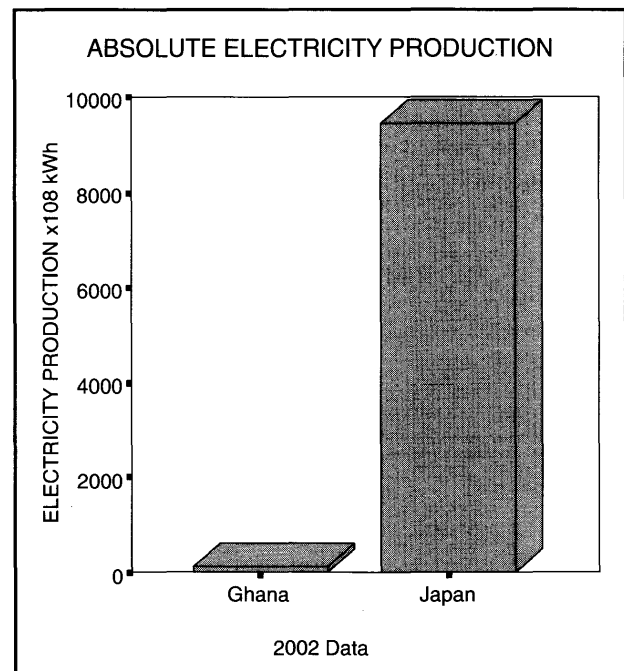
The main source of Electric energy for Japan is from Nuclear about 31%, this is followed by Natural gas with about 27%. Coal also contribute about 22% to the total electric energy, Petroleum about 10%, Hydro Electricity about 9%, with the rest taking the remaining 0.8% giving us a total of 100%

3) COMPARING THE TWO ENERGY SITUATIONS FOR THE TWO COUNTRIES

ABSOLUTE ENERGY PRODUCTION

SOURCE	COUNTRY	
	GHANA	JAPAN
Hydro Electricity	113.0 x10 ⁸ kWh	9450 x10 ⁸ kWh

The above diagrams shows the two energy situations compared for Ghana and Japan. The first one shows absolute energy production for the two countries and the second diagram shows average electric energy production person. It is very obvious that, the electric energy production for the two countries differ very largely since Japan is an industrialized



country and has a lot of manufacturing industries. Japan also depends a lot on electric energy for most of their activities.

But in the case of Ghana, it depends mostly on mining and agricultural activities hence do not consume much energy even though production does not still meet the countries energy requirements.

Production per person has increased a little as compared to that of production for the country because not all the energy produced in Ghana is consumed in the country as about 28% of the total electric energy produced in the country is exported to Togo & Benin as well as Ivory Coast which are neighboring countries.

In summary, Ghana obtains its main electricity from hydro-

power while on the other-hand Japan obtains its main electricity from nuclear resources. The electric sources and consumption differ for the two countries because of industrialization as Japan consumes more energy whereas; Ghana is an agricultural country and depends on natural sources

5. Lesson study on energy topics

The lesson on energy situations in Ghana and Japan was carried out in Tsunomine elementary school and in Johnan high school mainly so that, by the end of the lesson, pupils should be able to:

- i) Identify the various sources of energy both renewable and non-renewable in their environment and learn more about how they can be explored and used for human activities.
- ii) State the main sources of electric energy in Japan and in Ghana and then
- iii) Compare the main sources of energy in the two countries in terms of their sources and usage.

5.1 Lesson plan

A sample of the lesson plan presented in the two schools is made up of the following features:

- 1. **Week ending** - This is the date of the last day of the working week for which the lesson note is prepared
- 2. **Subject** - The particular subject to be taught (in this case Energy Education)
- 3. **References** - This is a statement of the various sources from which information for the lesson have been gathered
- 4. **Day and duration** - The day is the particular day of the week and the duration specifies the length of time

allocated to the lesson

- 5. **Topic/Sub-Topic** - It is the small area of learning or subject matter which is to be covered in the lesson
- 6. **Relevant Previous Knowledge (RPK)** - This is assumed knowledge or experience of the class.
- 7. **OBJECTIVES** - These indicate what is hoped will be achieved by the learner by the end of the lesson. This should have the following characteristics:
 - i. must be stated in behavioral terms
 - ii. must be specific
 - iii. must be measurable
- 8. **Teacher and learner activities.** These refer to the things that the teacher and the Pupils will do during the lesson. This includes teacher student interaction and student- student interaction among themselves.
- 9. **Teaching/Learning activities** - These are concrete objects that are provided for the pupils to interact with in the course of the teaching.
- 10. **Core points** - These are the main ideas derived from the lesson they are the summary of the concept, ideas that will be covered in the lesson and which pupils are expected to grasp.
- 11. **Evaluation** - The purpose of evaluation is to find out if the objectives set for the lessons have been achieved. This includes exercises, questions, quizzes etc. which are used to measure the extent to which pupils have acquired the knowledge, skills and attitudes specified in the objectives.
- 12. **Application** - The importance or the significance of the concept taught.
- 13. **Remarks** - This refers to the comments on the effectiveness of teaching and learning which may also include the problems or weaknesses observed during the lesson.

Format for lesson notes in basic science in Ghana

WEEKENDING:
SUBJECT:
CLASS:

REFERENCES(S)...

Day/ Duration	Topic/ Sub - topic	Objectives/R P K	Teacher and learner activities	Core Points	Evaluation
		<u>Remarks:</u>	<u>Application of knowledge</u>		

LESSON IN PROGRESS ON 14TH FEB. 2004
AT THE TSUNOMINE ELEMENTARY



LESSON IN PROGRESS ON 2ND JUNE AT
JOHNNAN HIGH SCHOOL



LESSON NOTE FOR GRADE FIVE (5) ON ENERGY SOUCES IN GHANA AT TSUNOMINE ELEMENTARY SCHOOL AT
ANAN CITY IN TOKUSHIMA PREFECTURE

WEEK ENDING: 16TH February 2004

REFERENCES: 1.Sc. in Basic schools (L. T. Nartey)

SUBJECT: Energy and Environmental Education

2.INTERNET and Goggle search

CLASS: Grade 5

Day/ Duration	Topic/ Sub-Topic	Objctives/R. P. K	Teacher and Learner Activities/ Teaching, Learner Materials	Core Point	Evaluation
Wednesday 14/02/2004 25minutes	<u>Topic</u> Energy <u>Sub-Topic</u> Energy sources in Ghana	OBJECTIVES: By the end of the lesson, pupils should be able to: i) Identify the various sources of energy both renewable and non-renewable. ii) State the main sources of energy in Japan and Ghana. iii) Compare the main sources of energy in the two countries in terms of their sources and usage. RPK: Pupils are familiar with the main sources of energy in Japan	TLMs: World map, Lesson note nicely written on flip charts, handouts with pictures of various cites of energy sources in Ghana. (attached) Introduction: Review the pupils' RPK by asking the ff. questions 1. What is energy 2. Mention the main sources of energy 3. What are the main sources of energy in Japan Development: Activity 1 i) Put pupils into groups of four (4) ii) Provide each group with the handouts iii) Guide pupils to read through the hand out whiles the teacher explains iv) Ask pupils to discuss their observations about the energy sources in Ghana. Activity 2 Guide pupils to do the following: i) Identify the main energy sources in Ghana. ii) State the Percentage consumption of hydroelectricity and petroleum in Ghana. iii) State the percentage consumption of biomass, coal and biogas in Ghana.	<u>Energy</u> in the ability to do work. The main sources of energy include: <u>Non-renewable</u> Such as petroleum, gas, coal and Nuclear. <u>Renewable</u> Such as sun, wind mill, biomass, solar electricity, Geothermal from the earth's core, nuclear fusion, wood and hydroelectricity The main sources of energy in Ghana are: a. Hydro 54.0% b. Petrol 36.96% c. Biomass 4.64% d. Biogas 1.4% e. Coal 3.0% f. Nuclear 0.0%	i) Mention two main sources from which Japan obtains its energy. ii) Mention two main sources from which Ghana obtains its energy. iii) What is the diff. between them

Day/ Duration	Topic/ Sub-Topic	Objectives/R. P. K	Teacher and Learner Activities/ Teaching, Learner Materials	Core Point	Evaluation
		REMARK:	Activity 3 Guide pupils to: i) Identify the percentage energy consumption in Japan. ii) Compare the energy sources of the two countries and their consumptions. Closure Ask pupils the following questions: Q1. What are the main sources of energy in Japan? Q2. What are the main sources of energy in Ghana? Application: Energy transformation from different sources in nature.	The main sources of energy in Japan are: a. Nuclear 31.2% b. Nat. gas 26.6% c. Hydro. 9.0% d. Coal 22.2% e. New 0.8% Ghana obtains its main sources of energy from the hydro-power with small amount coming from petroleum, biogas, biomass and coal.	

LESSON NOTE FOR GRADE ELEVEN (11) ON ENERGY SOURCES IN GHANA AT JOHANN HIGH SCHOOL IN THE TOKUSHIMA PREFECTURE

WEEK ENDING: 2nd JUNE 2004

REFERENCES: 1.Sc. in Basic schools (L. T. Nartey)

SUBJECT: ENGLISH/ENVIRONMENTAL CHEMISTRY

2.INTERNET and Goggle search

CLASS: GRADE 11

No. OF STUDENTS: 40

Day/ Duration	Topic/ Sub-Topic	Objectives/Relevant Previous Knowledge/(R. P. K)	Teacher and Learner Activities/ Teaching, Learner Materials	Core Point	Evaluation
Wednesday 02/06/2004 35minutes	Topic Energy Sub-Topic Energy sources in Ghana	OBJECTIVES: By the end of the lesson, pupils should be able to: i) Identify the various sources of energy both renewable and non-renewable. ii) State the main sources of energy in Japan and Ghana. iii) Compare the main sources of energy in the two countries in terms of their sources and usage. Relevant Previous Knowledge Pupils are familiar with the main sources of energy in Japan	Teaching, Learning Materials TLMs: World map, Lesson note to be presented on power point, handouts with pictures of various cities showing energy sources in Ghana. Introduction: Review the Pupils' previous knowledge by asking the following questions 1. What is energy? 2. Mention the main sources of energy 3. What are the main sources of energy in Japan Development: Activity 1 i) Put pupils into groups of four (4) ii) Provide each group with the handouts iii) Guide pupils to read through the hand out while the teacher explains iv) Ask pupils to discuss their observations about the energy sources in Ghana.	Energy is the ability to do work. The main sources of energy include: Renewable such as Biomass, solar, water, wind and Geothermal from the earth's core. Non-renewable such as fossil fuels which include oil, Natural gas and Coal; nuclear fusion, and wood.	i) Mention two main sources from which Japan obtains its energy. ii) Mention two main sources from which Ghana obtains its energy. iii) What is the difference between the two energy sources.

Day/ Duration	Topic/ Sub-Topic	Objectives/R. P. K	Teacher and Learner Activities/ Teaching, Learner Materials	Core Point	Evaluation																								
			<p><u>Activity 2</u> Guide pupils to do the following:</p> <ol style="list-style-type: none"> Identify the main energy sources in Ghana. State the Percentage consumption of hydroelectricity and petroleum in Ghana. State the percentage consumption of biomass, coal and biogas in Ghana. <p><u>Activity 3</u> Guide pupils to:</p> <ol style="list-style-type: none"> Identify the percentage energy consumption in Japan. Compare the energy sources of the two countries and their consumptions. Discuss why the energy sources and usage in the two countries differ. <p><u>Closure</u> Ask pupils the following questions: Q1. What are the main sources of energy in Japan? Q2. What are the main sources of energy in Ghana?</p> <p><u>Application:</u> Energy transformation from different sources in nature.</p>	<p>The main sources of energy in Ghana are:</p> <table border="0"> <tr><td>a. Hydro</td><td>54.0%</td></tr> <tr><td>b. Petrol</td><td>36.96%</td></tr> <tr><td>c. Biomass</td><td>4.64%</td></tr> <tr><td>d. Biogas</td><td>1.4%</td></tr> <tr><td>e. Coal</td><td>3.0%</td></tr> <tr><td>f. Nuclear</td><td>0.0%</td></tr> </table> <p>The main sources of energy in Japan are:</p> <table border="0"> <tr><td>a. Nuclear</td><td>31.2%</td></tr> <tr><td>b. Nat. gas</td><td>26.6%</td></tr> <tr><td>c. Hydro.</td><td>9.0%</td></tr> <tr><td>d. Coal</td><td>22.2%</td></tr> <tr><td>e. New</td><td>0.8%</td></tr> <tr><td>f. Oil</td><td>10.2%</td></tr> </table> <p>Ghana obtains its main sources of energy from the hydro-power with small amount coming from petroleum, biogas, biomass and coal. Because Ghana is an agricultural country while Japan is an Industrialized country.</p>	a. Hydro	54.0%	b. Petrol	36.96%	c. Biomass	4.64%	d. Biogas	1.4%	e. Coal	3.0%	f. Nuclear	0.0%	a. Nuclear	31.2%	b. Nat. gas	26.6%	c. Hydro.	9.0%	d. Coal	22.2%	e. New	0.8%	f. Oil	10.2%	
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		<p>REMARK:.....</p>																											

The time period for the lesson at Tsunomine elementary school was short so that the students wish we could continue with the lesson, whereas in Johnan high school, there was enough time for the students to learn and understand the various sources of energy from both renewable and non-renewable sources. Students could also state the main sources of electric energy for both Ghana and Japan in terms of their source and usage. In summary, all the students acquire the knowledge that, Ghana obtains its main electricity from hydro-power while on the other-hand Japan obtains its main electricity from nuclear resources. The electric sources and consumption differ for the two countries because of industrialization as Japan consumes more energy whereas Ghana is an agricultural country and does not consume much energy.

5.2 Students responses about the lesson

A. The students of the Tsunomine elementary school were so much surprised about the huge difference in energy

production and consumption.

- B. The students of the Johnan high school also commented that, Japan consumes a lot of energy so they depend on nuclear to supplement their energy consumption while Ghana does not consume so they use wood fuel and hydro-electricity which is from natural sources.
- C. That, Japan is an industrialized country with a lot of manufacturing companies and thus depends on artificial resources to supplement their energy requirement but Ghana is a developing country with few industries so they depend on natural resources for their energy requirements
- D. Students learnt for themselves that, Renewable energy resources are better than Non-renewable ones.
- E. That, Japan imports most of its energy resources while Ghana uses local resources and even exports some to its neighboring countries such as Togo & Benin as well as Ivory Coast.

6. Curricula content on energy topics for the two countries

Comparing the curriculum content for the two countries, the following observations were made:

1) Comparison on the basic level

For the Basic level, the science syllabi for basic schools in Ghana was compared with Tsunomine elementary school which is investigating on Energy Education for three years in Tokushima prefecture and the course of study for Japanese schools.

Grade Level	Ghana From Science syllabus for basic schools in Ghana	Japan Tsunomine elementary. (This School is investigating on Energy Education for three years) in Tokushima prefecture.
1	-	-Let's play with toys (life Skills) Students become aware of energy around them and use it
2	-	-Adventure, discovery, Exploration to know more in our neighborhood. (life Skills) Students explore energies around them
3	-	-Let's explore our neighborhood (Social Studies). -People working at our town. (Integrated. Studies) -Energy saving and practice, Nature of Light Magnets and Electrical Circuitry (Natural Science)
4	-Energy? -Sources of energy -Heat energy -Sound energy	-Solar energy, electricity and Photocells (Nat. Science) -The role of dams (Social. Studies) -Management of resources, waste and recycling waste. (Integrated Studies) -Use of nature such as sun for energy (Natural Science)
5	-How light travels -Reflection of light	-Let's think about the global Environment (Japanese Language) -Comfortable life and Conservation of the Environment (Social Studies) -Temperature and water (Natural Science)
6	-Electrical energy -Dry cells, -Sound Energy -Conductors and Insulators -Parts of an electrical bulb -Magnetic and Non-magnetic materials	-Comfortable home and energy conservation. (Home Economics) -Global Environment and peace (Social Studies) Students become aware that energy saving leads to enormous energy -Light and sound (N. Science)

For The case of Ghana, energy topics starts from grade 4 with what is energy where pupils are required to explain what energy is, state some sources of energy such as wood, coal, oil, natural gas, and food. Energy can also be obtain from petrol, kerosene, gas oil, liquefied petroleum gas (LPG), charcoal and biogas. The light and heat from the sun can also be harness to produce energy. Students are also introduce to heat energy to show how heat energy is produced such as chemical action, e.g burning, electricity, friction and from the sun. Students are also exposed to processes by which heat energy travel's such as conduction, convection and radiation. They are also introduced to how heat energy is used in the

home. The students are introduced at this stage to sound energy; how sound is produced, to interpret the meaning of sound from different sources and also to construct simple musical instruments.

At grade 5, students are taught to demonstrate how light travels in a straight line in the same optical instrument and also to demonstrate what happens to light when it travels from one medium to another medium. Students should be able to distinguish between transparent, translucent and opaque materials. Students are also expected to know the difference between diffusion and absorption of light. Demonstrate the reflection of light and also group materials

that reflect light from those which do not reflect light. Students should state the characteristics of plane mirrors and demonstrate images formed by plane mirrors.

At grade 6, students are exposed to how to construct simple series and parallel circuits, describe the components of a dry cell and state the functions of the parts of the dry cell. The pupils can also select conductors from a group of materials outline the characteristics of conductors, apply the knowledge on circuits to build mobile toys and enumerate the advantages and disadvantages of conductors and insulators.

For Japan, Tsunomine elementary, energy topics starts from grade 1 where students are allow to play with toys thus students become aware of energies around them and make use of it.

At grade 2, the main theme is adventure, discovery, and exploration in our neighborhood where students get to know more and better about our neighborhood thus they explore energies in the neighborhood.

At grade 3, students are allowed to explore in their neighborhood thus people working in our town. Students feel the need for energy saving, and practice it from studying people who work at energy producing plants.

Grade 4 is where students look at solar energy and electricity, the role of dams in electric energy production, management of resources, wastes and recycling wastes. Thus students learn about the use of the nature such as water, waste recycled resources to generate energy. Students also learn more about the use of nature such as sun for energy.

At grade 5, students consider the global environment and conservation of the environment as students enhance willingness to conserve the global environment by themselves. Students look at Temperature and water. That the student should understand that there is regularity in the way substances melt; by examining differences in the way substances melt according to temperature and quantity of water.

At grade 6, students learn how to device means for comfortable home and energy conservation. They also look at the global environment and global peace which are all energy related topics. Thus students become aware that energy saving, leads to enormous energy and practice energy saving in everyday life.

As can be observe from the table, most of the energy topics in the case of Japan are integrated into other subject areas apart from natural science where as in the case of Ghana, they are all treated under natural science syllabi.

2) Comparison on Junior High level

For the junior high level, the science syllabus for basic schools in Ghana was compared with the course of study for Japanese schools and the following observations were made.

Grade Level	<u>Ghana</u> From Science syllabus for basic schools in Ghana	<u>Japan</u> From course of study for Japanese schools (N. SCIENCE)
7	-	- Light and sound energy
8	-Forms of energy	- Electric current - Utilization of electric energy
9	-Light energy -Heat energy -Electrical energy -Magnetic energy -Sound energy	-Science and Technology and human beings - Energy sources

For the Junior high school level for Ghana, there is no energy topic for grade 7 and at grade 8, students should be able to give a clear definition for energy, describe various forms of energy, identify different sources of energy and use the knowledge acquired to build a biogas digester. Pupils are also required to know the effect of increase in human population on energy supply and describe some ways of conserving energy. They should be able to show the effects of energy on different substances and also perform activities to illustrate energy transformation.

At grade 9, students are supposed to mention the different sources of light, group light from various sources into natural or artificial light; students should be able to demonstrate the difference between translucent and opaque materials. With light energy, students should be able to demonstrate that light travels in a straight line, explain how the pinhole camera operates, to also demonstrate the formation of shadows in relation to umbra and pen-umbra regions. Students learn about reflection of light, state the laws of reflection and demonstrate some uses for smooth, plane surfaces. Students demonstrate the effect of refraction and can separate light into component colors referred to as dispersion. Students should be able to demonstrate heat as a form of energy and distinguish between heat and temperature. At grade 9, students are also expected to mention some ways of generating electrical energy and demonstrate the flow of electrical current using simple electrical circuit, wire an electrical plug and outline some effects of illegal connections. They should also be able to explain factors that

cause increase in demand for electricity and identify and describe the mode of operation of some electronic devices.

With sound energy, students should be able to demonstrate the magnetic field of force around a bar magnet, and demonstrate method of making magnets. Mention the compass and its uses. At this grade, student are to learn about how to produce sound energy by demonstrating how it is produced, they should be able to mention some musical instruments, state some uses of reflection of sound and also explain the difference between music and noise which ends the energy topics in grade 9.

At the junior high level for Japan, energy topics starts at grade 7 with light and sound energy, through observation and experimentation, students conduct experiments on reflection and refraction of light to find out the regularity of propagation of light as it reflects or refracts on a boundary surface between water and glass. They also conduct experiments on the functions of convex lens to find out the relationship among the position of an object, position of the image and the size of the image. Students conduct experiments on sound to get to know that sound occurs when an object oscillates and transmits through the air that the pitch and loudness produced are related to the vibration of the body.

At grade 8, through observation and experimentation, students find out about electric current. Students have the understanding of the relationship between the electric current and voltage as well as the effects of electric current, and develop elementary approach and ways of thinking about the electric current and magnetic field in association with their everyday life.

At grade 9, Students develop a clear understanding of the relationship between the utilization of energy resources and environmental protection, also the influence of the utilization of science and technology on human life, they will also develop scientific attitude to think of such subject in association with events of everyday life. At grade 9, students also came to learn that there are varieties of energy type utilized by human beings and also become aware of the importance of effective utilization of energy.

7. Conclusion

It has been observed from the comparative study that;

- i) In Ghana all the energy topics are taught under natural science but in Japan they are separated into several subjects from the early stages of education
- ii) In Ghana energy lessons are started at grade 4 but in

Japan, Tsunomine school at grade 1

- iii) In Ghana and in Japan energy topics are part of the school curriculum furthermore in Japan some schools are sponsored by private companies in the energy sector as a project to investigate into energy utilization and the practice of energy saving in schools as well as at home
- iv) In Ghana the lessons are more theoretical but in Japan they are practically oriented

Energy sources and consumption shows huge difference for the two countries as Japan is an industrialized country with a lot of manufacturing companies and thus requires a lot to support their energy requirement but Ghana is a developing country which depends mostly on mining and agriculture with few industries so they depend on natural resources for their energy requirements. Ghana's curricula do not involve integrated studies on energy topics and thus should involve other subject areas in handling energy topics at the basic level of education and in schools. Similarly, Japanese curricula should involve global viewpoint on energy consumption as continual dependence on non-renewable resources of energy is very risky and environmentally unfriendly.

References:

1. Teaching syllabus for Science in Ghana (September, 2001) for Elementary and Junior secondary schools in Ghana
2. Elaborate of course guidelines for Elementary and Junior high schools in Japan (May 1999) Ministry of Education, Culture, Sports, Science and Technology
3. Gyan, Asong, J., and Tufour J. K (2002). Primary Integrated Science textbook, teachers' manual and pupils' handbook for class Four (4), Five (5) and Six (6): Unimax Macmillan Ltd.
4. Nyavor C. B, Essiah J.W, Saka E.C (1999). Science for Junior Secondary Schools: Unimax Macmillan Ltd.
5. Ohuche, R. O. and Otaala, B. (1981). The African Child and His Environment. Pergamon Press
6. Antwi, K (1992) Education, Society and Development in Ghana. Unimax Publishers limited, Accra
7. Anamoah-Mensah, J (1998) Science Education as a Tool for National Development: The Missing Framework. Paper Prepared for Presentation at Eastern Washington University.
8. Benneh. M (2001). Education in Ghana and the Role of International cooperation in the Field of Education. A

talk delivered at a Seminar organized by the Ministry of Education and Science and the Center for International Cooperation in Education, Hiroshima University held in Tokyo.

9. National Education Forum (1999). Ministry of Education, Ghana Towards Sustaining an Effective National Education System
10. <http://www.ghana.gov.gh/studing/education/index.php>
11. http://cehd.ew.edu/faculty/ntodd/ghnanudlp/science_Education_Ghana.html
12. <http://www.staeweb.org/positions/STATEarth.html>
13. <http://www.agiweb.org/earthcomm/importan.htm>