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メタデータ	<p>言語: eng</p> <p>出版者:</p> <p>公開日: 2020-04-10</p> <p>キーワード (Ja):</p> <p>キーワード (En):</p> <p>作成者: MATSUURA, Toshihiko, SALIFU, Mwininumbu Osman</p> <p>メールアドレス:</p> <p>所属:</p>
URL	<a href="https://doi.org/10.32150/00006879">https://doi.org/10.32150/00006879</a>

# A Comparative Study of Science Lessons in Public Schools Between Ghana and Japan

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## ガーナと日本の公立学校における理科授業の比較研究

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### ABSTRACT

The study provides a comparison of science lessons between Ghana and Japan. The time allocated for the teaching and learning of science in both countries shows a big difference, also, number of times allotted on the school-based time-tables from the two schools compared did indicated some difference too. There is a well-resourced science lab as well as a computer laboratory for every school in Japan, but the opposite is the case in Ghana. Textbooks that are verified by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Japan for accuracy of content before distribution to schools are written in Japanese, and every student is given textbooks. In Ghana, textbooks are verified by the Curriculum Research and Development Division (CRDD) for content accuracy before distribution to all schools by Ghana Education Service (GES), but not all students in most cases are given the textbooks due to short in supply.

### 1. Introduction

Everybody will accept the fact that education is the sole journey to the development of every nation and that every nation depends a lot on science and the products of science. Science is a subject mankind cannot do without; it is not a

wonder to get to know that it forms part of the core curriculum of Ghanaian basic schools. Science education is the cultivation and disciplining the mind and other faculties of an individual to utilize science for improving his life, cope with an increasingly technological world, or pursue science academically and

professionally, and for dealing responsibly with science-related social issues.<sup>1)</sup> Science education has, therefore, become an integral part of the educational set-up in Ghana and has definitely been one of the compulsory study subjects. The study of science as a subject begins at the primary school (PS) level 1, all through to the senior high school (SHS) level 3.<sup>2)</sup> The Ministry of Education is generally overseeing education, with the Ghana Education Service (GES) being the management body.<sup>2)</sup> The Curriculum Research and Development Division (CRDD) is in charge for designing the educational curriculum and also verifies textbooks in the country. Less practical science lessons in Ghana is a call for concern for the growth of science education in the country as a result of inadequate or lack of science equipment and facilities. A study by Japan International Cooperation Agency (JICA) indicates that most science lessons in Africa are done in the chalk and talk style, which put children off science.<sup>3)</sup>

Japan has benefitted a lot from science and technology and it's among the world's most leading technological hubs in the world. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) is an administrative agency that takes charge of the overall affairs of education in the country, from curriculum design and implementation to enforcing and defining the educational rules and regulations. Science is taught as a compulsory subject, starting from grade 3 of PS through to grade 3 of SHS.<sup>4)</sup>

The main purpose of this study is to make comparisons through an analysis of the science lessons, materials as well as science facilities in the context of science education in public schools between Japan and Ghana.

## 2. Methodology

The content of grade 6 textbooks<sup>5, 9)</sup> from the two countries were analyzed because of the change and unavailability of the new science textbooks at junior high school (JHS) level in Ghana, the textbooks are yet to be distributed. Science textbooks for the various educational levels in Japan<sup>6-12)</sup> and Ghana<sup>15-21)</sup> were collected and scanned. Hakodate JHS attached to Hokkaido University of Education (HUE) in Hakodate, Japan as well as T.I. Ahmadiyya JHS in Wa, Ghana were cooperated with on the basis of analyzing science lessons, facilities and equipment. Time allocation for teaching science on the school time-table for both schools in both countries were also analyzed.

## 3. Results and Discussion

### 3. 1. Time Allocation for Science Lessons

Science education is compulsory in both countries. The study of science begins at PS grade 1 in Ghana, but begins at PS grade 3 in Japan. There is much time allotted for the teaching and learning of science at the PS and JHS levels in Ghana than in the case of Japan, but at the SHS it is the opposite.

At the PS grade 1-3 in Ghana, science is taught as Natural Science, and at PS grade 4-6, JHS, and SHS level as Integrated Science. Table 1 shows the annual time allotment for science education in each grade level in Ghana.<sup>13)</sup> According to the CRDD syllabus, a student will study science at the PS for 738 hours in 6 years, 477 hours at the JHS for 3 years and 411 hours at the SHS for a time period of 3 years. There are 6 periods for science lessons at the PS level a week, each period lasting for only 30 minutes.<sup>13)</sup> Therefore, each grade has 3 hours in

**Table 1** Annual time allocation in hours of science lessons in Ghana.<sup>13)</sup>

Grade/Year Level	PS						JHS			SHS		
	I	II	III	IV	V	VI	I	II	III	I	II	III
	123 hrs	123 hrs	123 hrs	123 hrs	123 hrs	123 hrs	159 hrs	159 hrs	159 hrs	137 hrs	137 hrs	137 hrs
<b>Total</b>	738 hrs						477 hrs			411 hrs		

**Table 2** Weekly time-table for grade 3 of T. I. Ahmadiyya JHS in Ghana.

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
7:10- 7:30	Morning Asseble				
7:30- 8:05	Religious & Moral Education	Religious & Moral Education	English	Social Studies	Physical Education
8:05- 8:40	English				English
8:40- 9:15		Dagaari	Arabic Studies	Information & Communication Technology	Basic Design & Technology
9:15- 9:40	Break Period				
9:40-10:15	Math	Math	Dagaari	Math	Social Studies
10:15-10:50					
10:50-11:25	Information & Communication Technology	Science	Science	Library Reading	Arabic
11:25-12:00					Moral Talk
12:00-12:10	Break Period				
12:10-12:45	Basic Design & Technology	Arabic Studies	Basic Design & Technology	Science	Close for Jumma Prayers
12:45-13:20		English			
13:20-13:55	Social Studies				
13:55-14:10	Closing Parade				

total for a week for each grade teacher. At the JHS level, there are 3 grades and each grade have 6 periods and 35 minutes per period of science lessons in a week,<sup>13)</sup> summing up to a total of 3.5 hours a week. Table 2 shows weekly time-table for grade 3 of T. I. Ahmadiyya JHS. Weekly science lessons are conducted following the regular school time-table just like any other subject on the time-table. The SHS level has a total number of 5 science periods a week, 40 minutes per period and 3 hours and 20 minutes a week.<sup>13)</sup>

Table 3 shows the annual time allotment for

science education in each grade level in Japan. Science as a subject is taught according to the course of study.<sup>14)</sup> The study of science starts from grade 3 of the PS with a study time period of 45 minutes per period.<sup>14)</sup> At the grade 3 of PS, science takes 90 hours, 105 hours each for grade 4, 5 and 6 per an academic year. At the JHS, 105 hours is allotted for grade 1, 140 hours each for grade 2 and 3 per an academic year with each hour representing 50 minutes of instructional time. Table 4 shows a typical weekly time-table for grade 3 of Hakodate JHS attached to HUE, Japan. The time-table changes

**Table 3** Annual time allocation in hours of science lessons in Japan.<sup>14)</sup>

Grade/Year Level	PS						JHS			SHS		
	I	II	III	IV	V	VI	I	II	III	I	II	III
	-	-	90 hrs	105 hrs	105 hrs	105 hrs	105 hrs	140 hrs	140 hrs	315-840 hrs	315-840 hrs	315-840 hrs
<b>Total</b>	405 hrs						385 hrs			945 hrs		

**Table 4** Typical weekly time-table for grade 3 of Hakodate JHS attached to HUE, Japan.

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
08:25-08:35	Reading Books				
08:35-08:45	Homeroom				
08:45-09:40	Science	Math	Home Economics	English	Arts
09:50-10:40	Physical Education		Home Economics	Math	Math
10:50-11:40	Arts	Japanese	Math	Japanese	Music
11:50-12:40	Social Studies	Science		Science	English
12:40-13:10	Lunch				
13:15-13:30	Cleaning				
13:35-13:50	Free Time				
13:55-14:45	Music	English	Moral Education	Social Studies	Physical Education
14:55-15:45	Japanese	Technical Course		Social Studies	Science
15:45-16:00	Homeroom	Social Studies			

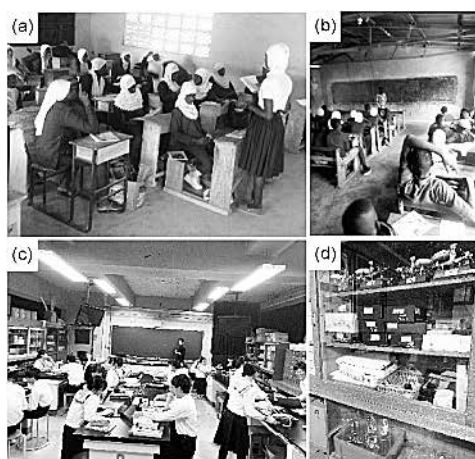
every week to satisfy the annual time allotment for all subjects. Science lessons are taught on the school-based time-table using 4 periods per week. The time allocation for science at the SHS is not specified or no fixed time allocated. One credit is 35 hours with 50 minutes a lesson. Four credits are needed for graduation. SHS students generally acquire 9-24 credits of science subject for 3 years.

### 3. 2. Science Lessons and Laboratories

PS and JHS in Ghana don't have science laboratories and equipment but all schools in Japan have science laboratories and equipment.

Students are engaged in more practical science lessons in Japan than in Ghana. Science teachers in both countries prepare lesson notes before teaching.

Figure 1 shows scenes of science lessons and equipment at the T. I. Ahmadiyya JHS in Wa, Ghana and Hakodate JHS attached to HUE, Japan respectively. In lesson delivery in Ghana, the science teacher needs to make reference to the syllabus, teacher's handbook and the science textbook to prepare lesson notes for every lesson before teaching. Other science textbooks may also be used in the lesson delivery and this act is accepted. The lesson notes are supervised



**Fig. 1** (a) and (c) are scenes of science lessons at the T. I. Ahmadiyya JHS, Wa, Ghana. (c) is a scene of science lesson, and (d) is a section of lab equipment at Hakodate JHS attached to HUE, Japan.

by the head teacher before lessons and sometimes by a circuit supervisor. Lesson notes preparation is mandatory and part of the whole teaching process. Most at times, lessons are conducted using the lecture method of teaching and learning with little or no experiments or field trips at the PS and JHS levels as shown in Fig. 1 (a) and (b). Science as an academic subject needs to be taught and learned more using the practical method and less of it in the theoretical method. Science lessons therefore should be delivered in a well-equipped science laboratory per the standards of education at the various levels of education. In Ghana, about 99% of the basic schools do not have science laboratories,<sup>2)</sup> hence all science lessons are delivered in the normal classroom settings. Lessons are delivered in a theoretical way, therefore giving little space for few science practical's to be performed or not at all in most cases. The few practical lessons that are carried out, in most instances are done on the writing-board in the theoretical way, there is also no study trips for science lessons due to lack of financial aid.

Most SHS in Ghana are equipped with science laboratories by the Ministry of Education, but not those in the underdeveloped regions and the rural areas. Most schools with laboratories are under-resourced, thereby making the teaching and learning of science a difficult task for both teachers and students alike.

In Japan, there is enough supply of science textbooks for every grade level and for every student. The syllabus design has placed a greater emphasis on the student-centered approach of learning,<sup>4)</sup> thereby minimizing the theoretical approach. The delivery of lessons are done using computers and audio-visual aids, while utilizing the science laboratory, as shown in Fig. 1 (c) and (d). Field trips are organized at sometimes for the student to be familiarized with nature. Teachers write lesson notes but these are rarely supervised. Every school has its own science laboratory with well-resourced laboratory tools and equipment. This gives both teachers and students the opportunity of carrying out successful science practical lessons.

### 3. 3. Science Textbook

Most schools and students in Ghana don't have access to the science textbooks but every student in Japan is given a textbook. Science textbooks in Japan are designed with so many colorful illustrations and real pictures than science textbooks in Ghana. Also, the content of the PS grade 6 science textbook for both countries reveals a great difference in science topics to be studied.

Figure 2 shows the covers of typical science textbooks for PS and JHS in Ghana.<sup>15-21)</sup> In Ghana, the textbook is designed in the context of the outline of the science syllabus, addressing the basic need of the syllabus. The science textbooks are certified by the CRDD and

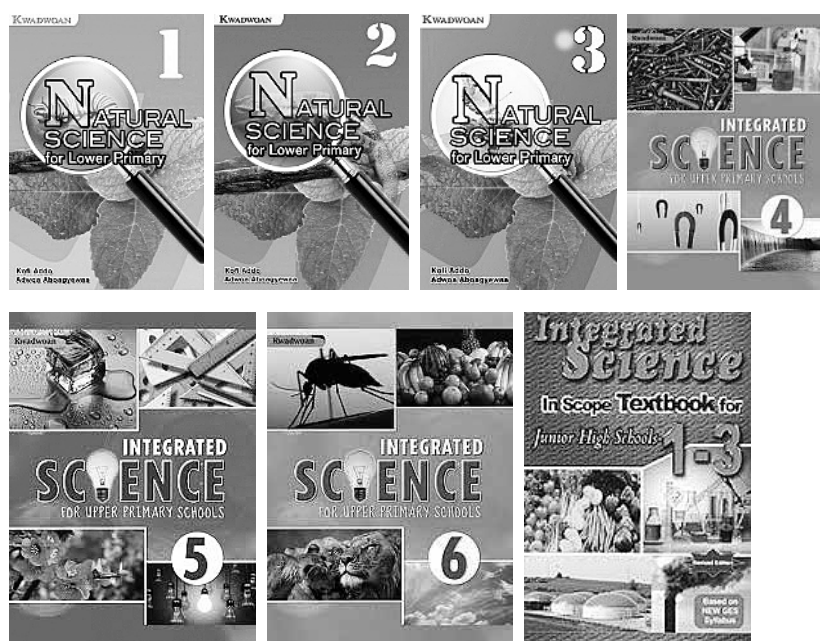


Fig. 2 Covers of science textbooks of schools in Ghana.<sup>15-21)</sup>

approved by the Ghana Education Service in close consultation with the Ministry of Education. The textbook is the basic instructional material available to both teachers and students, written in English for content search. This is a book comprehensively compiled based on a particular field of study, seeking to serve as an educational source of reference for educators in that field. In the case of Ghana, the science textbook is primarily the only readily available source for scientific information in the school settings due to the shortage or unavailability of other educational resources in science at the various basic schools. Yet, there is a mass shortage in supply of the science textbooks to the PS and JHS across the country.

Table 5 shows the content of PS grade 6 science textbook in Ghana. It reveals a comprehensive coverage of what the science syllabus entails. It covers the five prescribed sections of science content for grade 6 in the syllabus namely, Diversity of Matter, Cycles, Systems, Energy, and Interactions of Matter, covering all topics within a 91-page

document.<sup>5, 13)</sup> Students at grade 6 in Ghana will study 'Fruits & Seeds', 'Air', 'Water-Related Diseases', 'Life Cycle of a Mosquito' and many more.

Figure 3 shows the covers of typical science textbooks of public PS and JHS in Japan. MEXT verifies the content accuracy of the textbooks before distributing them to schools. Science textbooks approved by MEXT are used in all public schools. In particular, the textbooks for compulsory education (PS and JHS levels) have been provided free of charge since 1963. The government-approved science textbooks for PS and JHS are published from 6 and 5 publishers, respectively. For the SHS, 5 publishers are approved by MEXT to publish textbooks for 8 science subjects: Science and Our Daily Life, Basic Physics, Advanced Physics, Basic Chemistry, Advanced Chemistry, Basic Biology, Advanced Biology, and Basic Earth Science. Only 2 publishing companies publish Advanced Earth Science textbooks since there are few students who choose it. These are the curriculum content-based textbooks that will

**Table 5** Layout of the content of grade 6 science textbook in Ghana.<sup>5)</sup>

SECTION	UNIT	TOPIC	PAGE
DIVERSITY OF MATTER	1	Fruits & Seeds	1 -14
	2	Air	15-22
CYCLES	1	Life Cycle of Okro & Maize Plants	23-26
	2	Water-Related Diseases	27-31
	3	Life Cycle of a Mosquito	32-36
SYSTEMS	1	The Digestive System of Humans	37-42
ENERGY	1	Feeding in Plants	43-47
	2	Feeding in Animals	48-51
	3	Respiration	52-56
	4	Simple Electrical Circuit	57-70
	5	Simple Electronic Circuit	71-75
INTERACTIONS OF MATTER	1	Food Processing & Preservation	76-82
	2	Food Poisoning	83-87
	3	Natural Disaster-Flooding	88-91


**Fig. 3** Covers of science textbooks of PS and JHS in Japan.<sup>6-12)</sup>

tackle the basic objectives described in the syllabus design and content delivery. All science textbooks are written in Japanese and made available to every school and school going child

in Japan.

Table 6 shows the content of grade 6 science textbook in Japan that corresponds with the course of study. The textbooks has colorful



**Table 6** Layout of the content of grade 6 science textbook in Japan.<sup>9)</sup>

UNIT	TOPIC	PAGE
Introduction	Let's go out to the Science World	1 - 3
	The Earth & Life Creatures	4 - 7
1	Matter Burning & the Air	8 -21
2	Functions of the Animal Body	22-41
Advanced Learning 1		42-43
3	Functions of the Plant Parts	44-55
4	Life of Creatures, & the Environment	56-69
Advanced Learning 2		70-71
My Study		70-73
5	The shape of the Sun & the Moon	74-87
6	Formation & Change of the Earth	88-111
7	Function of Lever	112-129
8	Nature & Function of Aqueous solution	130-147
9	Electricity & Our Lives	148-163
Advanced Learning 3		164-165
10	Human & the Environment	166-174

images of both real and animated objects with in-depth study and illustrations, contained in a 176-page document.<sup>9)</sup> Students at grade 6 in Japan will study 'The Earth & Life Creatures', 'Matter Burning & the Air', and 'Functions of the Animal Body' among others. Science textbooks in Japan are reviewed at about 10 year-interval depending on the revision of the course of study.

#### 4. Conclusion

After digging into the nature of science lessons, facilities and materials in Ghana and Japan, a lot of things, as well as issues, have been drawn from this study. Issues such as time allotment for science education, science lessons and facilities, and science textbooks are elaborated below.

1. There is much time allotted for the teaching and learning of science at the PS and JHS in

Ghana than in the case of Japan. But the reverse is the case for SHS.

2. PS and JHS in Ghana don't have science laboratories or equipment. All schools in Japan are having science laboratories and equipment.

3. Science lessons at the PS and JHS in Ghana are mostly conducted in a normal classroom setting with little or no science practicals. In Japan, science lessons are conducted in a science laboratory, engaging in more science practicals.

4. Science textbooks in Japan are reviewed at every 10 year-interval depending on revision of the course of study and there is a science textbook for every student. In Ghana, science textbooks also reviewed but most schools in Ghana don't even have access to these textbooks due to shortage in supply.

5. Science textbooks in Japan are designed with so many colorful illustrations and real pictures than science textbooks in Ghana.

Much more similarities or differences in

science education in this study could have been sourced out and this probably will open the doors for more research into this topic. We hope, this study will set the basis for each country to learn from one another's positive aspects and possibly collaborate with each other to design a science educational system that will address issues in science education to improve basic education in both countries.

## Acknowledgments

Firstly, I will say “Alhamdulillah, Allah Akbar” to Allah for the wisdom, talent, and strength and keeping me alive to put this work together. Secondly, I express my sincere gratitude to my parents for their love and sacrifice. Also, Miss Akilata, Mr. Salih Saeed and Madam Fadilata all of N. J. A. College of Education, Wa. I will extend by warmers gratitude to MEXT scholarship, and to teachers and staff of both T. I. Ahmadiyya JHS and Hakodate JHS attached to HUE for their support and cooperation throughout the data collection stage.

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