MINISTRY OF EDUCATION
REPUBLIC OF GHANA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
UPGRADING EQUIRMENT FOR
SCIENCE EDUCATION
AT THE UNIVERSITY OF CAPE COAST
IN
THE REPUBLIC OF GHANA

MARCH, 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
INTEM CONSULTING, INC.

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PREFACE

In response to a request from the Government of Republic of Ghana the Government of Japan decided to conduct a basic design study on the Project for Upgrading Equipment for Science Education at the University of Cape Coast and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ghana a study from November 17 to December 16, 1995.

The team held discussions with the officials concerned of the Government of Ghana, and conducted a field study at the study area. After the team returned to Japan, further studies were made, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Republic of Ghana for their close cooperation extended to the teams.

March, 1996

Kimio Fujita

Kimio Fujita
President
Japan International Cooperation Agency

March, 1996

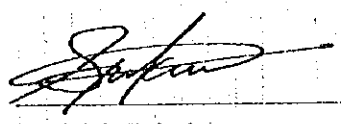
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Upgrading Equipment for Science Education at the University of Cape Coast in the Republic of Ghana.

This study was conducted by INTEM Consulting, Inc., under a contract to JICA, during the period from November 8, 1995 to March 25, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Ghana and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

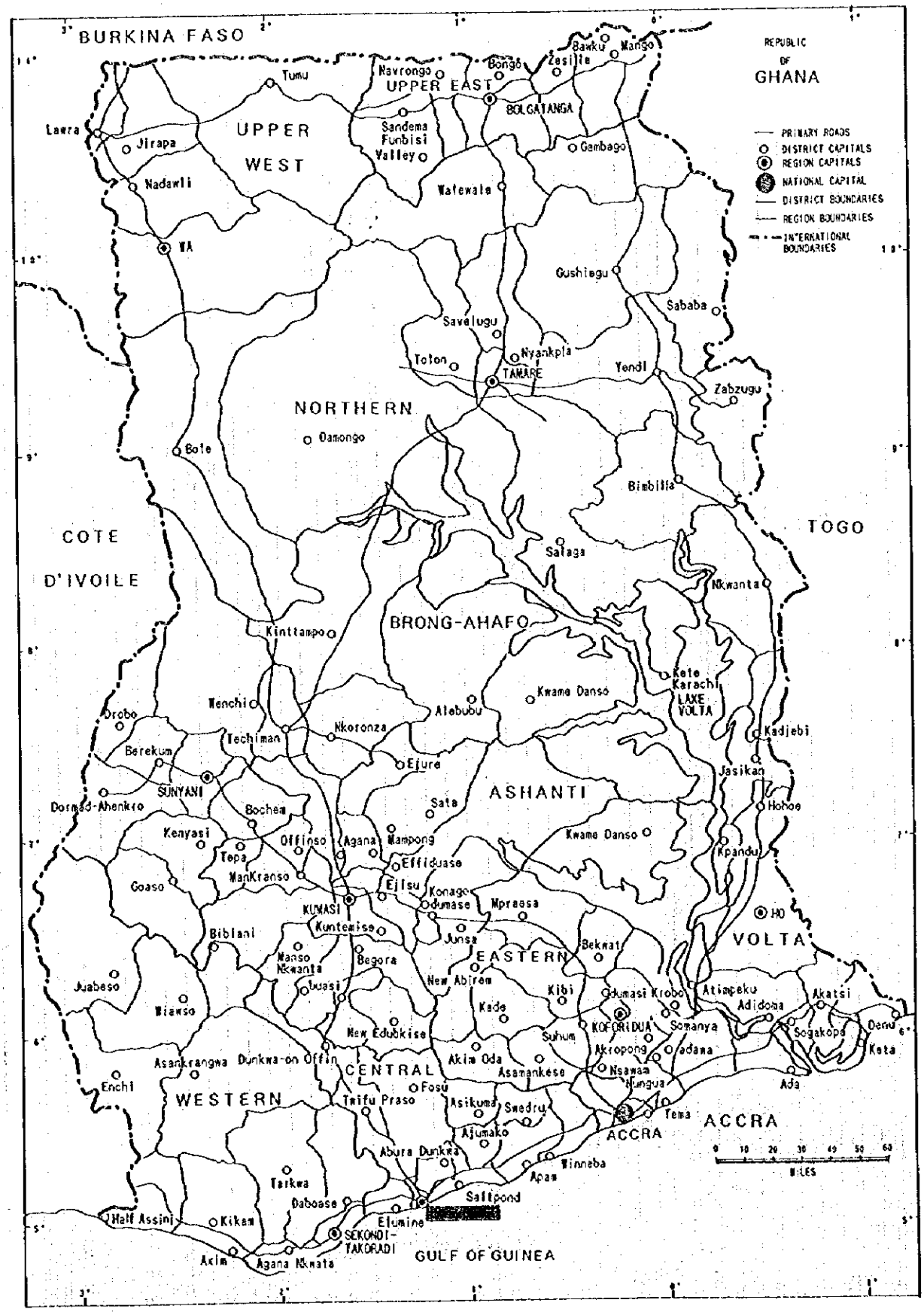
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



Soichi Takai
Project manager,
Basic design study team on
The Project for Upgrading Equipment
for Science Education at the
University of Cape Coast
INTEM Consulting, Inc

LOCATION OF THE PROJECT SITE



ABBREVIATIONS LIST

CIDA	Canadian International Development Agency
ERP	Economic Recovery Programme
IMF	International Monetary Fund
IDA	International Development Association
JSS	Junior Secondary Schools
NCHE	National Commission for Higher Education
NICTE	National Implementation Committee on Tertiary Education
ODA	British Overseas Development Administration
PFMRP	Public Financial Management Reform Programme
PIP	Public Investment Programme
SSS	Senior Secondary Schools
TEP	Tertiary Education Project
UCC	University of Cape coast
USAID	United States Agency for International Development

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Appendices

Chapter 1 Background of the Project

Chapter 1 Background of the Project

The Republic of Ghana is located in the middle of West Africa. It's surrounded by Burinka Faso on the North, Togo on the East, Cote D'Ivoile on the West, with the Gulf of Guinea on its South. It is an almost rectangular country, 238.5 square kilometers, an area approximate to our central Japanese island of Honshu. The geography of the whole country is relatively flat, and consists of regions ranging from desert, arid, prairie, and forest zones. River branches of the Volta Basin spread through much of the country, flowing into the Volta Lake, which is said to be the world's largest man-made lake.
Ghana's climate in the north is rather dry, brought from the Sahara Desert winds. But further to the south, the damp monsoon air from the Gulf of Guinea brings a more tropical climate. Although the southern region is hot and humid throughout the year, the rainfall is low.
In 1994 the total population was 17,198,000. This represents an increase of 4.6% from 1993. 8,350,000 of that total are under fifteen years old, and that young age bracket consists of 48.6% of the total population.

Although originally a colony of England, Ghana became the Africa's first independent country after World War II in March of 1957 as a member of the British Commonwealth of Nations, and in July of 1960, it was established as the Republic of Ghana. Since then, the seat of political power has changed many times, but in December of 1992 it became a completely citizen-ruled democracy under a unicameral system, including an elected President, and that political structure has continued to the present day.

The Country's main industry is the primary industries as agriculture, with main farming crops of cocoa, tobacco and corn, forestry, with timber products, fishery, as well as mining producing gold, diamonds and bauxite. Industrialization has been pursued substantially since their independence, thus the main industrial areas are the secondary industries such as petroleum, textiles, and metal ores. The tertiary industry related service businesses and commerce has grown among adjacent African countries, and the country shows a good balance of industrial structure.
Starting in the late 1970's, the country went through economic recession, an Economic Recovery Programme (ERP) was set in motion in 1983 under the economic support of international financial agencies, IDA and IMF. As a result, Ghana's

economic growth rate continued stable by the late 1980's for over 5%. But into the 1990's, due to world-wide economic decline and decrease of export of cacao which is the main export product of Ghana, its international payments was deteriorated. Then, in combination with escalated unemployment percent and chronic spiraling inflation, the country began to fall into an economic slump.
The growth in the Gross Domestic Product (GDP) has remained rather low, and the increase for 1994 comparing with the previous year fell into low 3.8%. The goal for the end-of-the-year inflation rate, based on the consumer price index, was set at 15%, but it actually turned out to be twice that, or 34.2%. And the currency rate exchange between the U.S. and Ghana was 54.4 Cedi per 1 US$ in 1985, but in 1994, there were 970 Cedi to 1 US$, a plunge in their currency value down to 1/18. The Cedi exchange rate seemed to stabilize for a while after 1989, but since 1993, it has shown a downward plunge increase of an annual 40-50%, and since this is related to inflation control policies, serious measures need to be imposed.

In order to improve Ghana's economic foundation, and make a long term economic growth, the development of human resources is critical. Recognizing that it is very necessary to have a very capable supply of personnel in each branch of education, emphasis is being placed on a major rehabilitation plan for the education system. Along those lines, since improving the level of elementary and secondary education is dependent on elevating the whole educational programme, there has been a strong push toward expanding school facilities and equipment and improving the quality of teachers. But the lack of science teachers in the elementary and secondary schools who have had sufficient teacher training is a serious problem. Therefore, the improvement and expansion of science and related faculties of the University of Cape Coast (UCC), which is the major science teacher training institute in the country, is the most critically important project of the country's educational fields.
But there is a considerable shortage of experimental and educational equipment in the Faculties of Science and Education and relevant sections at UCC, and most of those equipment are either obsolete or impaired beyond use; to the point that effective classwork is impaired. In order to improve the current situation, the government of Ghana has requested a grant from the Japanese government for the purpose of upgrading the quality of educational equipment for the Science Faculty and other sections at this UCC.

Chapter 2 Contents of the Project

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2-1 Objective of the Project

In order to improve Ghana's economic situation, the most important objective is to send capable human resources in each field of society by means of producing the qualified human resources. Since obtaining human resources for the industry sector in economic rehabilitation is so important, it is critical to cultivate a resource of science-oriented personnel. It is thus necessary to expand the science education. But in order to achieve that, it is absolutely essential to have science teachers with sufficient knowledge and ability, along with appropriate experimental/practical facilities and equipment.
However, in the science education in the fundamental level of primary and secondary education, the actual situation of educational efficiency is hampered by tremendously lacking in science teachers educated in teacher training course.

By turning out science teachers, the University of Cape Coast directly benefits the secondary education level (SSS), and furthermore, by producing teachers who attend the various teacher training colleges, UCC indirectly has a very positive effect on the science education programme of the primary education level (Primary and JSS).

But there is a considerable shortage of experimental and educational equipment in the Faculties of Science and Education and related fields at the University of Cape Coast, and most of those equipment are either obsolete or impaired beyond use, to the point that a functional science classes are not being achieved. Also, because of the shortage of scientific experimental and educational equipment at the teacher training colleges, science education is impeded there as well.

In order to improve the current problem of the Science and Education Faculties of the university, and also for two other training training colleges, the government of Ghana has requested a grant from the Japanese government for the purpose of upgrading the educational equipment.

Under the suggested plan, it is the purpose to strengthen the science-teacher

training by providing the necessary equipment for UCC, the only institution in the country that produce science teaching certificates for SSS, as well as two other teacher training colleges.

2-2 Basic Concept of the Project

2-2-1 Outline of the Request

This project is a plan for providing educational equipment for the science and education faculties, and related divisions, at the University of Cape Coast, with the intent of furnishing better training for the science teachers in the elementary and secondary education level.

1) Faculty of Science / Department of Botany
   - General laboratory equipment ; laminar flow cabinet, Ice Maker, Refrigerator, etc.
   - Microscopic equipment ; Microscope, Microtome, Varistain, etc.
   - Measurement equipment ; Flame photometer, pH meter, etc.
2) Faculty of Science / Department of Physics
   - Measurement equipment ; Oscilloscope, LCR meter, DC potentiometer, etc.
   - Laboratory equipment ; e/m apparatus, Plank's apparatus, etc.
   - Experimental material ; Lens set, Glass block, etc.
3) Faculty of Science / Department of Chemistry
   - General laboratory equipment ; Water jet pump, Water still, etc.
   - Analytical equipment ; AA, Flame photometer, etc
   - Glass blowing equipment ; Glass lathe, Glass drilling equipment, etc.
4) Faculty of Science / Department of Zoology
   - General laboratory equipment ; Refrigerator, Dry bath, etc.
   - Measurement equipment ; Water quality meter, Conductivity meter, etc.
   - Microscopic equipment ; Microscope, Microtome, etc.
   - Field work equipment ; Insect net, Soil insect collector, etc.
5) Faculty of Science / Computer Centre
   - Computer training equipment ; PC, Printer, LAN, etc.
6) Faculty of Science / Electronic Workshop
   - Electronics circuit repair equipment ; Desoldering equipment, Transistor

checker, Electronic Tool set, etc.

7) Faculty of Science / Mechanical Workshop
   - Metal work equipment ; Lathe machine, Press brake, Guillotine cutter, Milling machine, etc.

8) Faculty of Science / Educational Supporting Unit
   - Educational supporting equipment ; Copying machine, Printing machine, OHP, etc.
   - Pickup car, Micro bus

9) Faculty of Education
   - A/V Unit equipment ; Studio editing equipment, 35mm camera, Dark room equipment, etc.
   - Workshop equipment ; Universal planer, Band saw, Wood lathe, etc.
   - Science laboratory equipment ; Top pan balance, Hot plate, Stopwatch, etc.
   - Science laboratory equipment for OLA and Komenda Teacher Training Colleges

2-2-2 Study on the Requests

(1) Suitability of the Request

Relevant facts concerning the request are listed below.

1) Faculty of Science / Departments of Botany, Physics, Chemistry and Zoology
   These four majors are fundamental subjects in elementary and secondary education field, and represent the most essential field of this plan.

2) Faculty of Science / Computer Centre
   There is some sharing of computer laboratory equipment among the Science and other faculties in carrying out the students' computer education.
   Particularly in the Science Faculty programming and hands-on computer data processing is a critical field of education.

3) Faculty of Science / General and Electronic Workshops
   These are practice laboratories providing a technical diploma course for laboratory technicians in vital experimentation. They will share the maintenance and repair of the educational equipment of the Science Faculty and related sectors, and there will be proficient maintenance control of the allotted equipment.

4) Faculty of Science / Educational Supporting Unit

A unit to support each department in sharing the supervision of equipment to efficiently implement educational activities involving experiments, practice assistance, supply preparations, etc., for each major field within the Science Faculty. It is essential that supplies and materials provided are not wasted.

5) Faculty of Education / AV Unit

A practical laboratory to provide on-site audio-visual equipment for technological education in development and production at the elementary and secondary levels. This is very effective in promoting the caliber of education.

6) Faculty of Education / Workshop

A workshop for elementary and secondary level practice in production technology for on-site materials. Maintenance and repair is included within this faculty.

7) Faculty of Education / Science Education Laboratories

Facilities essential for practical education in techniques for science experiments, result evaluations, and experiment planning, in the fields of chemistry, physics, and biology, which are basic areas for obtaining a teaching certificate for elementary and secondary level, or college teaching.

8) Teacher Training Colleges (OLA and Komenda)

Practical education facilities which the students of UCC use to obtain a teaching certificate. With its materials and equipment for college teacher-training, it is considered a model case.

(2) ManagementDiscussion

Concerning the requested equipment, high-technical management techniques are unnecessary, nor were they petitioned for, and the technical skills and knowledge of the technical staff at the University is very sufficient to handle any necessary administration.

(3) Discussion on Aspects of Operation and Maintenance

Since the experimental equipment for each department is currently stored in storage exclusive to that department's use, and is managed under the jurisdiction of the laboratory technicians of that department, operation and maintenance is not a problem. They are already equipped with inventory list, which are logged in conjunction with each day's experiment plans, and a good

system for monitoring the laboratory equipment is already in place.
Also, the laboratory technicians know basic repair techniques, and they have the ability to keep up with general maintenance and repair. At times, in the case of more serious breakdown, manufacturers' specialists are needed, but there are outlet stores and factory-trained technicians in the city of Accra, so operation and maintenance service is not a problem.

(4) Discussion on the Equipment Plan

All the equipment requested were intended for basic and practical applications in rudimentary education. Equipment for postgraduate and teachers were not included, or mentioned in the plan. The contents reflect the main purpose of the plan. There is some duplication between some of the equipment requested and existing, and each department has requested somewhat the same equipment, but through organized consolidation and sharing, the minimum essential quantities should be considered.
The request seems to have a shortage of storage supplies, so furnishing more of those items is being checked into.

Below is an itemized list of equipment, and their estimated quantities.

1) Because UCC is a comprehensive university, the use of the providing equipment was limited to the undergraduate students. However, there is some overlap in a few sophisticated equipment requisitions from the several departments. From a standpoint of efficiency and operation and maintenance, some items are planed as common equipment, if they can be placed in a particular department where they would be utilized the most, while still benefitting several others in need.
2) Some analysis equipment with automatical operation apparatus had been requested, but the repairs and upkeep for such machinery is rather complicated, so other similar but hand-operated devices, in conjunction with the existing equipment already in operation, should suffice. These items were eliminated or changed to some of the items applied for.
3) According to the regulations of Japanese grant aid, the items of Ghana's request which were prioritized as being low-essential or low-quality, were eliminated from the list.
4) Although not requested, some items were added to the list which are needed for

appropriate maintenance after provision and implementation.

5) In the case of the equipment which were requested from the same department and have same functional duplication, a item with the most appropriate specification were included in the plan.

6) It was basically decided on appropriate amounts, within the parameters of the established quantities according to the policy below:

- Equipment used for presentation : one set per department
- Experimental Equipment
  used for each student : same as number of student per class
  used for group : same as number of laboratory tables

2-3 Basic Design

2-3-1 Design Concept

In regards to the equipment plan for the project, the following standards were used in examining and selecting the equipment:

(1) Standards for Selecting the Equipment

1) The use of the equipment under consideration is limited to the educational purposes by the students enrolled in the Faculties Science and Education at UCC, who intend to become science instructors and/or science education staff in the future. The project does not include the equipment which may be used for research by the graduate students and by the instructors.

2) The need for equipment was determined according to the curriculum of the concerned departments.

3) The following types of equipment are excluded from the consideration: equipment which may require high electrical power, special materials or consumables; equipment which is difficult to maintain and preserve; highly sophisticated equipment which may require costly operation and maintenance and special skills.

(2) Standards for Setting the Design Size

The size was determined based on the appropriate quantity and the set-up. Consideration was given to the effective use of equipment, the number of the students, the methods of use, and the number and the size of the laboratories.

2-3-2 Basic Design

(1) Overall Plan

The equipment proposed for the project is educational equipment most of which will be used for experimental and practical use. And the locations where they will be set up are the existing laboratories and practice rooms. The concerned departments are currently equipped with the appropriate number of large laboratories, and the necessary utilities are all complete; therefore, there is no problem in setting up the proposed equipment.

(2) Equipment Plan

The name and the purpose of the main equipment proposed for the project is listed in Table 2-1. The equipment is listed in the Appendix 6.

Table 2-1 Major Equipment with Application

Equipment	Application
[Science Faculty / Botany Department]	
Laminar flow cabinet	Supply clean air for experiment
Centrifuge	Separation of liquid specimen
Microscope (monocular)	Experimental observation for students
Microscope (binocular)	Experimental observation for students
[Science Faculty / Physics Department]	
Measuring microscope	Measuring micro scale dimensions
Decade capacita	Experiment of electronic circuit
Optical bench	Optical experiment
Spectrometer	Spectrological experiment
[Science Faculty / Chemistry Department]	
Atomic absorption spectrophotometer	Qualitative/quantitative analysis of metal
Bomb calorimeter	Measuring calory of materials
Infrared spectrophotometer	Qualitative/quantitative analysis

Gas chromatograph	Separation and analysis of gas/liquid
Polarographic analyzer	Qualitative/quantitative analysis of ion
Glass lathe	Glass blowing training
Grinding machine	Glass blowing training
Annealing oven	Glass blowing training
[Science Faculty / Zoology Department]	
Stereoscopic microscope	Micro-stereoscopical observation
Inflatable boat	Field sampling survey
Microscope (monocular)	Experimental observation for students
Microtome knife sharpener	Sharpening microtome knife
Microscope (binocular)	Experimental observation for students
[Science Faculty / Computer Centre]	
Personal computer	Computer training
UPS	Protection from power down
Software set	Computer training
[Science Faculty / Electronic Workshop]	
Desoldering tool	Repairing electronic circuit
Color pattern generator	Checking VTR circuit
DC power supply	Repairing electrical circuit
[Science Faculty / Mechanical Workshop]	
Press brake	Metal work training
Milling Machine	Metal work training
Lathe	Metal work training
[Science Faculty / Educational Supporting Unit]	
Over head projector	Instructional training
Printing machine	Printing instructional material
Pickup car	Transporting equipment for field work
Microbus	Transporting students for field work
[Education Faculty]	
Studio editing system	Producing video soft
Enlarger	Photographic training
Dark room equipment	Photographic training
Universal planer	Wood working training
Wood lathe machine	Wood working training
Band saw	Wood working training
Flame photometer	Analysis of metals
Water still	Producing distilled water
Potentiometer	Measuring electric potential difference
Burette	Quantitative analysis of liquid
Water bath	Constant temperature experiment
Ammeter	Measuring electric current
Microscope (monocular)	Experimental observation for students

(3) The Specification of the Main Equipment

Table 2-2 indicates specifications for the major equipment planed for the project:

Table 2-2 Major Equipment with Application

Equipment	Application
[Science Faculty / Botany Department]	
Laminar flow cabinet	950Wx1,600Hx850Dmm, w/heppa filter
Centrifuge	15,000rpm, w/refregiratof
Microscope (monocular)	magnification x40-600, w/lighting
Microscope (binocular)	magnification x50-1,500, w/lighting
[Science Faculty / Physics Department]	
Measuring microscope	hori.200xver.160mm, magnification x5.5
Decade capacita	capacity 200pF-11.111microF, DC150V
Optical bench	rail length 1,500mm, w/screen and lens
Spectrometer	max range 8mm, corimeter 23mm-f200mm
[Science Faculty / Chemistry Department]	
Atomic absorption spectrophotometer	190-900nm, w/holocasord and aircompressor
Bomb calorimeter	bomb type
Infrared spectrophotometer	single beam, 7,800-350cm^{-1}
Gas chromatograph	packed column, w/data analytical devices
Polarographic analyzer	auto-sampler, metals of Al,Cd,Fe,Hg,etc.
Glass lathe	centre width 800mm, 0-150rpm
Grinding machine	max dia. 500mm, 0-300rpm
Annealing oven	1,200Wx1,200Dx1,600Hmm, max.temp.800℃
[Science Faculty / Zoology Department]	
Stereoscopic microscope	magnification x20-40, stage dia. 75mm
Inflatable boat	capacity 4 persons(370kg), 3.5Hp motor
Microscope (monocular)	magnification x40-600, w/lighting
Microtome knife sharpener	250/300rpm, stone width 32-48mm
Microscope (binocular)	magnification x50-1,500, w/lighting
[Science Faculty / Computer Centre]	
Personal computer	CPU pentium, 60Hz, HDD 300MB
UPS	capacity 750VA, backup time 10 minutes
Software set	Data base, Microsoft, FORTRAN, Pascal
[Science Faculty / Electronic Workshop]	
Desoldering tool	pump cap. 18l/min(600mmHg), 100W-300/480℃
Color pattern generator	8 color pattern, PAL system
DC power supply	output 0-25V, 10A
[Science Faculty / Mechanical Workshop]	
Press brake	12ton, stroke 150mm
Milling Machine	work range 400(U/B)x200(F/B)x610(R/L)mm
Lathe	center 550mm, slide 210mm, 80-1,800rpm

[Science Faculty / Educational Supporting Unit]	
Over head projector	f=276-300mm, projection distance 1.5-4m
Printing machine	mimeographing type
Pickup car	2.5l diesel engine, double cabin for 6
Microbus	3.5l diesel engine, for 30 passengers
[Education Faculty]	
Studio editing system	video camera, monitor, VTR, AV mixer
Enlarger	format 24x36mm,lens mount 40mm,max 60x80cm
Dark room equipment	developer, temp. controler, dryer, sink
Universal planer	max width 300mm, 7,000rpm
Wood lathe machine	bed length 1,800mm, max dia.500xL1,200mm
Band saw	400/600/800rpm, capacity 180mm
Flame photometer	120-160mol/Na, for Na,K,Li,Ca,Ba
Water still	3 litter/hr, outside cooling
Potentiometer	0-100mV,0-1V, 1-2V, accuracy 0.1%
Burette	25ml, 1/10ml graduation, w/stand, cock
Water bath	36 litter, +5-99℃ of room temp.
Ammeter	0-100mA, 0-1A, 0-10A
Microscope (monocular)	magnification x40-600

(4) Equipment Installation plan

The installation of the planned equipment is shown on the equipment list of the Appendix 6.

Chapter 3 Implementation Plan

Chapter 3 Implementation Plan

Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Concept

Considering this project is to be implemented through the grant aid provided by Japanese government, the following principle items should be taken into account in the execution of the project.

1) In order to carry out the installation and transition smoothly within the schedule, the engineers from the supplier and/or manufactures should be sent for installation and supervision.
2) Engineers should include a supervisor, an equipment engineer and a mechanical engineer. As needed, engineers from the manufacturers of the third country may be considered.
3) The engineers sent to the area engage in all matters including delivery, installation, commissioning, instruction on the usage and other matters related to the transitions. They should expect smooth operation by the local personnel after the equipment is turned over to them.
4) The sufficient explanation about the installation procedure and its schedule should be provided for obtaining mutual consent from those in charge from the Ministry of Education, which has the supervisory function for the project, and to those from the University of Cape Coast, including the President of the University and those responsible persons from the Science and Education Faculties, which are responsible for the implementation of this project. At the same time, an agreement for the Ghana side to provide full cooperation in necessary matters should be obtained.

3-1-2 Consideration on Implementation

The following matters should be noted in implementing the project:

1) To examine thoroughly the locations for the equipment to be installed, and handle the building and the facilities carefully,
2) To clarify accountability for equipment installation and the necessary utility in order that the installation may be carried out smoothly,
3) To put the best efforts forth in assuring the best possible methods in preventing the personnel and equipment accidents in the installation, and
4) To assure that good communication among the Ghana side, the Consultant and the equipment supplier be established in each stage of the implementation so that good rapport may be maintained among them.

3-1-3 Scope of Works

The division of responsibilities of both Japanese and Ghana sides in implementing the project is as shown in Table 3-1:

Table 3-1 Scope of Works

Scope	Japan	Ghana
1. Equipment		
- Procurement	○	
- Installation	○	
- Commissioning	○	
- Instruction for usage		
2. Facility work		
- Utilities supply work		○
- Electric wiring to equipment	○	
- Airconditioning and ventilation		○
3. Securing storage space		
4. Transportation and customs clearance		
- Transportation to Ghana	○	
- Customs clearance	○	
- Tax exemption		○
5. Banking arrangement and paying necessary commission		○
6. Expedited legal procedures related to entry, stay and exit of concerned personnel		○
7. Effective/proper operation of equipment provided		○
8. Necessary approval and permits related to project implementation		○
9. Disbursement of costs for related work not covered by the project		○

3-1-4 Consultant Supervision

In regards to the supervision of the implementation, sufficient discussions with the local organizations involved in the project and the equipment supplier should take place, and a detailed plan for the supervision of the project should be established. When the implementation takes place, consultants specialized in specific equipment should focus on their own supervision and put their best efforts forth in smooth implementation of the project.

The following points should be considered in supervising the implementation:

1) In order to carry out the installation of the equipment smoothly, set up concrete arrangements with Ghana side to the exact methods of delivery and installation from the very first phase.
2) Study and consult with the suppliers about delivery and installation of the equipment and make a judgement about whether or not the procurement plan, equipment specifications and installation schedule are appropriate.
3) Prior to the shipment of the equipment, the equipment inspection should be conducted thoroughly.
4) In delivering the equipment, assure that the equipment meets the design specifications, the installation is properly carried out and the commissioning results are good. Assure also that the instruction of equipment usage is done properly.

3-1-5 Procurement Plan

In regards to the supply of the equipment, in order that the supplied equipments may be used effectively, the following matters should be carefully taken into consideration: maintenance service needs to be available in the area, and determine whether or not the parts and expendable items are available in the area. Especially, careful study and discussion should be held in regards to the operation of the equipment after it is installed. Consideration of the location of Ghana should be made, and analyze and check whether or not the after-service from the equipment makers in our country and/or the makers from the local area or the third country is available.

As to most of the equipment included in this project, quite many Japanese manufacturers have agencies in Ghana, and basically the service agencies on the locally produced items and the items from the third country is available in Ghana. For these reasons, the suppliers would be Japanese makers, local (Ghana) makers/agencies, and also the third country (England) makers.

3-1-6 Implementation Schedule

The implementation process is shown in Table 3-2:

Table 3-2 Implementation Schedule

Months	1	2	3	4	5	6	7	8	9	10	11	12
Detail Design	(Field Study)											
		(Analysis)										
				(Confirmation)								
Supply and Installation							(Manufacturing)					
								(Transportation)				
									(Installation, Inspection, Hand over)			

3-1-7 Obligations of Recipient Country

The following works and services will be provided by the Ghana side as its own cost.

1) Tax Exemption

Make an arrangement so that the custom duties on the equipment supplied from Japan and the third country be exempted.

2) Banking Arrangement and Payment Authorization

Open a bank account, issue a authorization to payment and be responsible for paying the necessary cost.

3) Necessary arrangement and advice in legal procedure related to entry, stay and exit of personnel concerned the project implementation

Provide necessary assistance and advice in legal procedures related to entry, stay and exit of the personnel of the consultant and suppliers engaged in the project.

4) Disbursement of cost for related work not covered by the grant aid

Bear all expenses for the facility constructing work and purchasing items such as furniture and related equipment which are not included in the Project.

3-2 Operation and Maintenance Plan

Take into consideration the fact that the operation budget by the University of Cape Coast, which is to execute the plan in the area, is not sufficient, the equipment which may require a tremendous cost in operation and maintenance were all excluded from this project. The operation and maintenance cost would include the cost for materials, consumables, electricity and fuel needed for the operation of the equipment provided.

If project is implemented and equipment are installed, additional expenditure for operation and maintenance including utilities, materials, consumables, etc. will be estimated as below:

- Faculty of Science ; 10,480,000 Cedi/year
- Faculty of Education ; 2,034,000 Cedi/year
- Teacher Training College ; 295,000 Cedi/year (per one college)

Chapter 4 Project Evaluation and Recommendation

Chapter 4 Project Evaluation and Recommendation

Chapter 4 Project Evaluation and Recommendation

4-1 Project Effect

(1) Benefit of the University of Cape Coast

1) Faculty of Science

In each department in the Science Faculty, taking the number of students into consideration, more than enough space and laboratories are available; however, most of the equipment used for the experiment was installed ten to fifteen years ago. They were few in type as well as in number. Besides, hardly anything was replenished since then. Consequently, the Faculty had not been able to provide sufficient amount of experiments or practices that were customarily needed for the science education.

By implementing this project, the Faculty will be equipped with the appropriate amount of necessary equipment; thus, enabling the Faculty to provide experiments and practices which are in accordance with the curriculum. Also because the required time may be shortened and the experiments may be conducted more efficiently, the Faculty may be able to handle more students, thus, enabling the University to meet the future increase in enrollments.

By implementing this project, it would bring direct benefit to not only about 650 students in the departments in the Science Faculty but also it would enhance the educational benefits for those students in other departments who earn science credit hours.

2) Faculty of Education

In the science laboratories of the Education Faculty, the teaching method and the tautology had been taught through the use of the science experiments. Through the use of the proposed equipment, more appropriate level of experiments could be conducted more efficiently. And by replacing the existing broken equipment owned by A/V Unit with planned equipment, the students would be able to actually produce video software for educational use, and a greater result would be brought about.

By providing the equipment in the Education Faculty, total of 1,020 students, among which 370 are the students of the Science Education Department and about 650 students of the Science Faculty, would directly benefit from it. It would

also bring benefit to the students of other faculties and departments and also those from other universities who sign up for the courses required to become a teacher.

3) Workshops

The equipment installed in the Electronic and the Mechanical Workshops of the Science Faculty, and in the General Workshop of the Education Faculty is intended for the students who study the Technical Diploma Course, but that equipment would be able to provide various types of technology that are in accordance with the curriculum. Those equipment, also, could be utilized for maintenance, repair and processing purposes of planed and/or existing equipment of each department. Thus, the mechanical repair work on the educational equipment can be done on campus, and that would result in a drastic curtailment of the maintenance cost.

(2) Benefit at the Teacher Training Colleges

Currently, the conditions of the existing equipment in the science laboratories at the Teacher Training Colleges are far from a desirable state. There are no experiments or practices conducted for the science course, and lectures are the only things available to the students. At the two colleges which are the principals for project, both of them own very little equipment necessary for them.

By having the equipment provided for the science experiments at the Teacher Training Colleges, students who hope to become teachers in the future would be able to receive high quality science education, and that would enable them to acquire ability to provide more effective education to others when they actually start teaching. These equipment would bring benefit not only to the students of the Teacher Training Colleges but also the practical education of those in the education courses at the University of Cape Coast.

(3) Benefit on the fields of Primary and Secondary Education

It is estimated that the number of those science teachers who do not have necessary qualifications or capabilities is estimated to be about 2,750 and 40,000 in secondary and the primary education, respectively. The number of those who enter into the science teaching fields from the University of Cape Coast and/or the Teacher Training Colleges are limited to only 160 in the Secondary

and 2,350 in Primary Education. Moreover, educational opportunities for science experiments for these students are very insufficient because of the lack of the laboratory equipment.

Through this project, equipment in the field of science teacher development at UCC would be made available, education and teacher training in the field of science for those students who intend to become teachers would be conducted more efficiently, and that would make it possible for the institution to send out people who receive a higher level of education and training in science field. Most of the students from the university become SSS instructors, thus, providing direct benefit on secondary education; however, by supplying instructors to the Teacher Training Colleges, this project would bring about indirect benefit on the primary education as well.

This Project would improve the science education level of primary and secondary education in Ghana through enhancing the quality of teachers. Consequently, it would contribute to enhancing the science education level in the country.

4-2 Recommendation

In order for this project to be implemented and the equipment provided through the Project be utilized more efficiently, the following should be improved.

1) Dissolving the Scanty Operational Budget

This project emphasizes the importance of the equipment which is low in operation and maintenance costs; however, the operation budget in the proposed fields is still very small. It cannot be denied that the small budget may become a hindrance to the effective operation of the equipment.

It is hoped that the annual budget of the University be increased, and the ratio to the operation cost be increased also so that classes, experiments and practices may be conducted effectively.

2) Improvement in the Skill Level and Capabilities

The proposed equipment is easy to use and does not require special or high level knowledge or skills; however, it is necessary to increase the knowledge level pertaining to the handling of the equipment, of those who use and maintain it directly.

3) Improvement in Equipment Maintenance and Handling

Ensure the safekeeping equipment and avoid the outbreak of damage at the time of carry into and out, through making an arrangement for necessary storage space for the provided equipment.

APPENDICES

APPENDICES

Appendix 1

MEMBER LIST OF THE SURVEY TEAM

Leader	Ms. Yumiko YOKOZEKI Development Specialist, JICA
Project Coordinator	Ms. Reiko AKEZUMI Second Basic Design Study Division Grant Aid Study and Design Department, JICA
Project Manager and Science Education	Mr. Soichi TAKAI INTEM Consulting, Inc.
Equipment Planner	Mr. Yasumichi DOI INTEM Consulting, Inc.
Quantity Surveyor	Mr. Shuhei KUBOTA INTEM Consulting, Inc.

Appendix 2 Survey Schedule

	Official Member	Project Manager	Equipment Planning	Procurement Planning
Nov. 17 (Fri)		Lv. Narita via Frankfurt		
Nov. 18 (Sat)		Lv. Frankfurt via Accra		
Nov. 19 (Sun)	Lv. Abidjan via Accra	Data Check		
	Team Meeting			
Nov. 20 (Mon)	Courtesy call on the Ministry of Education (MOE) and Ministry of Finance (MOF), the Japanese Embassy, JICA			
Nov. 21 (Tue)	Meeting with MOE / Visit IBRD and ODA			
Nov. 22 (Wed)	Accra → Cape Coast, Meeting with University of Cape coast (UCC) and Survey of Facilities			
Nov. 23 (Thu)	Meeting with UCC and Ola College, Survey of Facilities			
Nov. 24 (Fri)	Komenda College, Survey of Facilities and Meeting with UCC			
Nov. 25 (Sat)	Meeting with Member of JOCV / Data Check			
Nov. 26 (Sun)	Cape Coast → Accra / Data Check			
Nov. 27 (Mon)	MOE, Discussion on a draft of Minutes		Market Survey (Local Agent of Equipment)	
Nov. 28 (Tue)	Visit MOE (Data Collection)	Market Suvey (Local Agent of Equipment)		
	Signing the Minutes of Discussions at MOF			
Nov. 29 (Wed)	Visit UNICEF and British Council		Market Suvey (Local Agent of Equipment)	
	Lv. Accra Via London	Accra → Cape Coast		
Nov. 30 (Thu)	Av. London	Meeting with UCC		
Dec. 1 (Fri)	Lv. London via Narita	Meeting with Botany Department Zoology Department of UCC		
		Visit Development Office (UCC Drawing Collection)		
Dec. 2 (Sat)	Av. Narita	Data Check		
Dec. 3 (Sun)		Data Check		
Dec. 4 (Mon)		Meeting with Science Education Department and Physics Department		
Dec. 5 (Tue)		Meeting with Chemistry Department and Computer Center, Workshop		
Dec. 6 (Wed)		Meeting with Faculty suporting unit, Survey of Laboratory		
Dec. 7 (Thu)		Survey of Laboratory		
Dec. 8 (Fri)		Meeting with UCC, Cape Coast → Accra		
Dec. 9 (Sat)		Survey of Tema		
Dec. 10 (Sun)		Data Check		
Dec. 11 (Mon)		Visit MOE (Data Collection)	Market Suvey (Local Agent of Equipment)	
Dec. 12 (Tue)		Meeting with UCC		
Dec. 13 (Wed)		Visit MOE (Data Collection)	Market Suvey (Local Agent of Equipment)	
		Lv. Accra via London		
Dec. 14 (Thu)		Ar. London		
Dec. 15 (Fri)		Lv. London via Narita		
Dec. 16 (Sat)		Ar. Narita		

Appendix 3 List of Party Concerned in the Recipient Country

The Embassy of Japan	
Mr. Junji Yamazaki	: First Secretary
Japan Iternational Cooperation Agency (JICA)	
Mr. Akio Yagi	: Resident Representative
Mr. Toshiharu Kai	: Deputy Resident Representative
Mr. Soma	: Sr. JOCV
Ministry of Education	
Mr. Harry Sawyerr	: Minister
Mr. J. S. Dalymple Hayfron	: Chief Director
Mr. T. H. Coleman	: Planning Offiser
Mr. Note	: Project Management Unit
Ghana Education Service (GES)	
Mr. R. S. Amartey Amarh	: National Coordinator, Science Resource Centres Project
Mr. Yaw Dwomoh	: Director, Planning, Budgeting Monitoring & Evaluation
Ministry of Finance	
Dr. Wiliam A. Adote	: Director of International Economic Relations Division (IERD)
Mr. Kwasi Opoku	: Economic Planning Officer of IERD
The World Bank	
Mr. Greg Hancock	: Senior Operations Officer
The British Council	
Mr. Tom Cowin	: Director
British Overseas Development Administration (ODA)	
Mr. Howard Tyers	: Education Field Manager
UNICEF	
Ms. Adjoa Sey	: Officer in Charg of Education
University of Cape Coast	
Prof. S. Kwasi Adjepong	: Vice Chancellor
Prof. C. Ameyaw Akumfi	: Pro. Vice Chancellor
Prof. D. N. Offei	: Dean, Faculty of Science
Prof. C. E. Stephens	: Head of Botany Department
Dr. E. C. Quaye	: Senior Lecturer, Botany Department
Mr. T. K. Baidoo	: Senior Technician,Botany Department
Dr. John Blay, Jr.	: Senior Lecturer, Zoology Department
Dr. K. Yankson	: Senior Lecturer,Zoology Department
Mr. C. T. Abebe	: Principal Technician, Zoology Department
Mr. M. A. Eghen	: Principal Technician, Zoology Department
Dr. D. K. Dodoo	: Head of Chemistry Department
Dr. V. P. Y. Gadzekpo	: Senior Lecturer, Chemistry Department
Dr. F. S. Tayman	: Senior Lecturer, Chemistry Department
Mr. Emmanuel Quagaine	: Lecturer, Chemistry Department

Mr. E. Boafo Adu	: Senior Technician, Chemistry Department
Mr. Albert Bening	: Technician, Chemistry Department
Mr. A. K. Ampah	: Technician, Chemistry Department
Dr. A. Ayensu	: Ag. Head of Physics Department
Mr. Kofi Anane Femin	: Lecturer, Physics Department
Mr. P. K. Mensah	: Lecturer, Physics Department
Mr. L. A. Ahen	: Chief Technician, Physics Department
Mr. David Manso	: Senior Technician, Physics Department
Mr. Richard Anozie Quainoo	: Assistant Technician, Physics Department
Mr. George Harny Arthur	: Principal Technician, Electronic Unit
Prof. D. N. Offei	: Head of Mathmatics Department
Dr. Ben Gordor	: Lecturer, Mathmatics Department
Mr. Daniel Obuobi	: Ag. Coodinater, Computer Center
Mr. Romeo Bugyei	: Programmer, Computer Center
Mr. W. N. A. Hammond	: Ag. Chief Technician, Science Workshop
Mr. J. H. Fynn	: Technician, Science Workshop
Prof. J. Anamuah Mensun	: Dean, Faculty of Education
Mr. John Gyening	: Ag. Head, Science Education Department
Dr. J. K. Tufuor	: Senior Lecturer, Science Education Department
Mr. R. Quarcoo Nelson	: Lecturer, Science Education Department
Mr. R. A. Kesson	: Senior Technician, AV Unit
Mr. F. K. Dzineku	: Faculty Officer
Mr. John K. E. Edumadzie	: Senior Reserch Assistant
Mr. J. C. Assam	: Senior Administration Assistant
Mr. M. F. Qemitne Arthnr	: Architect, Development Office
Mrs. E. E. Amenumey	: Deputy Finance Officer, Finance Office
Mr. Canham Kofi Donkor	: Planning Officeer, Planning Unit

Komenda College

Ms. Rose E. Newman	: Principal