ANNEX 3. Input to the Project
ANNEX 3-1 Japanese Experts

	Name	Organization	Title	Duration	1999(FY)	2000	2001	2002	2003	2004	Remarks
Long-term	Yumiko Yokozeki	IFIC,JICA	Chief Advisor	28/3/2000-27/3/2003							
	Chisato Tanaka		Chief Advisor	15/6/2003-28/2/2005							
	Takafumi Konaka	JOCA(Japan Overseas Cooperation Association)	Project Coordinator	9/3/2000-8/3/2000							
	Kazuro Shibuya	JICA	Administrative Coordinator/Education Planning	10/2/2002-28/2/2005							
	Shigeyuki Tanaka	JICA	Monitoring and Evaluation	1/5/2004-1/5/2005							Up to May 2005
	Eiichiro Nagao	Akashi Shimizu High school,Hyogo Prefecture	Mathematics Education	6/4/2000-5/4/2003							
	Takeshi Yamasaki	Sanda Elementary school,Sanda Municipality,Hyogo Prefeture	Mathematics Education	1/6/2002-31/3/2004							
	Yukiharu Kobayashi		Mathematics Education	6/6/2003-28/2/2005							
	Yuji Otsuka	Oita-Maizuru High school,Oita Prefecture	Science Education	1/6/2000-31/5/2002							
	Takashi Soma		Science Education	6/4/2000-5/4/2003							
	Yuki Hayashimoto	Kita High school, Nagoya Municipality,Aichi Prefecture	Science Education	10/5/2002-9/5/2004							
	Kenji Ohara		Science Education	15/6/2003-28/2/2005							
Short-term	Minoru Yoshida	Shinsyu University	Support for Analysis of Baseline data(Mathematics)	3/9/2000-30/9/2000		★					
	Kenichi Nakabayashi	Miyazaki University	Support for Analysis of Baseline data(Science)	3/9/2000-23/9/2000		★					
	Norihiro Kuroda	Hiroshima University	Support for Baseline Presentation Seminar	8/11/2000-21/11/2000		★					
	Tatsushi Kobayashi	Miyazaki University	Support for INSET(Science)	29/1/2001-18/2/2001		★					
	Shinji Iida	Fukuoka University of Education	Support for INSET(Mathematics)	29/1/2001-18/2/2001		★					

ANNEX 3. Input to the Project
ANNEX 3-1 Japanese Experts

	Name	Organization	Title	Duration	1999(FY)	2000	2001	2002	2003	2004	Remarks
	Hiromitsu Muta	Tokyo Institute of Technology	Educational Evaluation	21/3/2001-2/4/2001		★					
	Koji Sonezaki	Takio Junior Secondary school,Oita Municipality,Oita Prefecture	Support for Science and Mathematics fair(Science)	26/3/2001-5/4/2001		★					
	Yoshiaki Kawano	Zyonan Junior Secondary school,Oita Municipality,Oita Prefecture	Support for Science and Mathematics fair(Science)	26/3/2001-5/4/2001		★					
	Takeshi Ozaki	Ezoe Elementary school,Hyogo Prefecture	Support for Science and Mathematics fair(Mathematics)	26/3/2001-5/4/2001		★					
	Keiji Matsumoto	Ieshima Eelementary school,Hyogo Prefecture	Support for Science and Mathematics fair(Mathematics)	26/3/2001-5/4/2001		★					
	Yoshinori Tabata	Hiroshima University	Educational Administration	21/5/2001-1/6/2001			★				
	Hiromitsu Muta	Tokyo Institute of Technology	Educational Evaluation	16/3/2002-24/3/2002				★			
	Koichiro Yoshinaga	Takada Elementary school,Oita Municipality,Oita Prefecture	Support for Science and Mathematics fair(Science)	28/3/2002-7/4/2002				★			
	Shigehiro Nakamura	Fukuoka University of Education	Support for INSET(Science)	11/10/2002-27/10/2002				★			
	Shinji Iida	Fukuoka University of Education	Support for INSET(Mathematics)	18/10/2002-27/10/2002				★			
	Maki Tomita	Tokyo Institute of Technology	Educational Evaluation	9/2/2003-9/3/2003				★			
	Kazuya Yamamoto	Attached Elementary school to Faculty of science of education and welfare,Oita Prefecture	Support for Science and Mathematics fair(Science)	30/7/2003-9/8/2003					★		
	Tomohiro Matsumoto	Arakawa Elementary school,Hyogo Prefectrure	Support for Science and Mathematics fair(Mathematics)	30/7/2003-9/8/2003					★		
	Norihiro Kuroda	Hiroshima University	Educational Administration	26/3/2004-7/4/2004						★	
	Minoru Yoshida	Shinsyu University	Support for INSET(Mathematics)	18/4/2004-2/5/2004						★	
	Kenichi Nakabayashi	Miyazaki University	Support for INSET(Science)	14/4/2004-2/5/2004						★	

ANNEX 3-2 Provision of Machinery and Equipment

ANNEX 3-2-1 Amount of Machinery Equipment

ITEM/FY	1999(From March)	2000	2001	2002	2003	2004	Total
Granted equipment purchased in Japan	0	3,225	2,635	2,190	1,511	0	**9,561**
Granted equipment purchased in Ghana	0	15,110	0	5,369	6,417	0	**26,896**
Carried equipment by Japanese specialists	0	14,780	1,279	1,556	0	0	**17,615**
Total (Unit: Thousand Yen)	0	33,115	3,914	9,115	7,928	0	**54,072**

ANNEX 3-2-2
List of Machinery and Equipment
Over Japanese Yen 1,600,000

J.P.Y.	Item	Model	Quantity	Place installed	Utilization Situation	Remarks
2000	4WW Vehicle	Nissan Patrol SGL 4.2G	1	Accra/Akuapem North	Good	
2000	Minibus Vehicle	Nissan Urvan 2.7D	1	Accra/Akuapem North	Good	
2000	4WW Vehicle	Nissan Patrol SGL 3.8G	1	Accra/Akuapem North	Good at the moment but frequent troubles in the past	Special maintenance care to be taken.
2000	4WW Vehicle	Toyota Landcruiser GX	1	Accra/Akuapem North	Good	
2002	4WW Vehicle	Toyota Landcruiser Standard	1	Accra/Akuapem North	Good	In April 2003 it had accicent at Manmong.It took alomost one year to

ANNEX 3-2-2
List of Machinery and Equipment
Japanese Yen 100,000- 1,600,000

JFY	Item	Model	Quantity	Place Installed	Utilization Situation	Remarks
2000	Printer	HP Laser Jet 2100M	1	Akuapem North, Resource Center	Good	
2000	Small-sized photocopy machine	Canon PC780	1	Akuapem North,PTC office	Good	
2000	Small-sized photocopy machine	Canon PC890	1	Tamale,Resource Center	Good	
2000	Desktop computer	COMPAQ Presario	2	Akuapem North, Resource Center	Good	
2000	Laptop computer	Apple iBook	1	Accra, STM Office	Good	
2000	Laptop computer	Toshiba	1	Accra, STM Office	Good	Battery runs out shortly but operating normally.
2000	Photocopy machine	CanonNP6035	1	Akuapem North,PTC office	Good	Regular maintenance needed
2000	Big-size generator	HONDA Nishihatsu GX620/V	1	Akuapem North,PTC office	Not working	Overused at National workshop in April 2004.Change of parts to be done immediately.
2000	Desktop computer	COMPAQ Presario	6	Adansi West, Resource center and Akuapem North, Resource Center	Some are not in good order	A floppy disk drive of one of them has been condemed.
2000	Small-sized generater	HONDA EG2500	1	Tamale,Resource Center	Good	
2000	Video camera	SONY TRV66	1	Akuapem North, Resource Center	Good	
2000	Desktop computer	LEO	2	Accra, STM Office	Good	One was out of order and replaced with new PC.
2000	Conference desk/chair		1 set	Accra, STM Office	Good	
2000	Desktop computer	Compaq Desktop Pro	5	Akuapem North, Resource Center and Tamale, Resource Center	Good	
2000	Photocopy machine	CanonNP6035	1	Accra, STM Office	Good	Front-back copy function is not working well at the moment.
2000	Projector	EPSON EMP7350	1	Akuapem North, Resource Center, STM office	Good	
2000	Printer	HP Laser Jet 1100	6	Accra, STM Office, Akuapem North, Resource Center, Tamale, Resource Center and Adansi West, Resource Center	Good	
2000	Duplication machine	RISOGRAPH CR1610	1	Akuapem North, Resource Center	Good	
2000	Desktop computer	Apple Mac G4	1	Accra, STM Office	Not working	Low processing performance, frequent freezing. Installed Norton System Work as remedy however it is not working.
2000	Desktop computer	Sony PCV-R62V7	1	Accra, STM Office	Working but often freezing	
2000	Printer	RICOH IPSIO COLOR2100	1	Accra, STM Office	Out of order and disposed	100V

ANNEX 3-2-2
List of Machinery and Equipment
Japanese Yen 100,000- 1,600,000

FY	Item	Model	Quantity	Place installed	Utilization Situation	Remarks
2000	Projector	Sony VPL-CS1	1	Akuapem North, Resource Center	Good	
2000	Laptop computer	Apple Mac G3 Power Book	1	Akuapem North, Resource Center	Working but problem of power supply	With cable, it could work, however, with battery not.
2000	Printer	Canon LBP-910	1	Akuapem North, Resource Center	Good	
2000	Laptop computer	Sony VAIO	1	Akuapem North, Resource center	Out of order and disposed	
2000	Digital camera	Sony DSCS70	1	Akuapem North, Resource Center	Good	
2000	Laptop computer	Toshiba Dynabook	1	Akuapem North, Resource Center	Joint part between monitor and machine became very weak	
2000	Colour laser printer	OKI MICROLINE	1	Accra, STM office	Out of order	100V
2000	Video camera	SONY DCR-PC110		Akuapem North, Resource Center	Good	
2001	Laptop computer	Toshiba	2	Akuapem North, Resource Center	Good	Used by Science and Mathematics counterpart
2001	Photocopy machine	Canon6416	1	Adansi West, Resource center	Good	
2001	Medium-size generator	HONDA EP6500S	1	Akuapem North, PTC office	Good	
2001	Video camera	SONY DCR-VX2000E	1	Akuapem North, Resource Center	Good	
2001	Laser jet printer	Canon LBP-1810	1	Akuapem North, Resource Center	Out of order and under repair. Connected to 220V instead of 100V.	100V
2001	Laptop computer	Apple iBook M8597J/C	1	Accra, STM Office	Good	Used by Administrative Coodinator
2001	Bubble-Jet Printer	Canon BJM70	1	Accra, STM Office	Good	
2002	Small-sized generator	HONDA EP2500	1	Accra, STM office	Regular maintenance to be done.	
2002	Duplication machine	RICOH(RISOGRAPH CR1610)	1	Accra, STM office	Good	
2002	Photocopy machine	CANON NP6317	1	Akuapem North, Resource Center	Good. Sometimes paper jam	
2002	Large-sized generator	KUBOTA 10KVA	1	Akuapem North, Resource Center	Good	Manitenance to be done
2002	Split-type Air conditioner	GE 1.5HP	3	Adansi West, Resource Center	Good	One had serious damage on electric part because of over-current but it has been replaced.
2002	Desktop computer	Compaq EVO D310V	4	Akuapem North, Resource Center	Good	

ANNEX 3-2-2
List of Machinery and Equipment
Japanese Yen 100,000- 1,600,000

FY	Item	Model	Quantity	Place installed	Utilization Situation	Remarks
2002	Split-type air conditioner	GE 1.5 HP SmartSense	3	Akuapem North, PTC office and Resource Center	Good	One at Resource center, Computer room is not working.
2002	Laptop computer	Toshiba Satellite 1410-S105	1	Akuapem North, Resource Center	Good	
2002	Laptop computer	Toshiba Satellite 1410-S174	1	Akuapem North, Resource Center	Good	
2002	Laptop computer	Toshiba Dynabook V5/410PME	1	Akuapem North, Resource Center	Good	
2003	Desktop Computer	Compaq D310 Evo (Tower Case)	6	Tamale,Resource Center, Adansi West, Resource Center, Akuapem North, Resource Center and Accra, STM office	Good	
2003	Duplication machine	RISOGRAPH CR 1610 EP SR 812068	1	Tamale, Resource Center	Good	
2003	Laset Jet Network Printer	HP 2300n	1	Accra STM office	Good	
2003	Laset Jet Network Printer	HP 4200n	1	Akuapem North, Resource Center	Good	
2003	Local Area Network System	3 COM Network Switch	1	Accra STM office	Good	
2003	Local Area Network System	3 COM Network Switch	1	Akuapem North, Resource Center	Good	
2003	Digital Photocopier	Canon IR 3300	1	Akuapem North, Resource Center	Good	
2003	Intercom Hybrid System	Panasonic PABX KXT 308	1 set	Accra STM office	Good	
2003	Desktop Computer	HP 330 EVO	10	Akuapem North, PTC office, Tamale, Resource Center, Adansi West, Resource Center	Good	
2003	Labtop Computer	HP 9010X	3	Accra STM office and Akuapem North, Resource Center, STM office	One at Accra is out of order and being repaired	
2003	Duplication Machine	RISOGRAPH CR 1610 EP SR 81206588	1	Adansi West, Resource Center	Good	
2003	Big-size generator	Pramac Lifter	1	Tamale, Resource Center	Good	

ANNEX 3-3 Counterpart Training in Japan and Third Countries(as part of the project)

ITEM/FY	1999(From March)	2000	2001	2002	2003	2004	Total	Remarks
Counterpart training in Management	0	2	3	3	3	6	17	
Counterpart training in Science and Maths	0	2	2	3	3	0	10	
JICA Long-term scholarshp(apart from Japan)	0	0	0	0	0	1	1	South Africa
Total	0	4	5	6	6	7	28	

Counterpart Training in Japan and Third Countries as part of the Project

	Name	Organisation	Title	Training Duration	1999(FY)	2000	2001	2002	2003	2004	Training institutions	Remarks
Counterpart training												
2000	Prof. C. Ameyaw-Akumfi	GES	DG	23/7/2000-6/6/2000		★					Fukuoka University of Education, Hiroshima University	
	Mr. Emmanuel Osei	PTC	Principal	6/9/2000-24/9/2000		★					Hiroshima University	
	Ms. Rosina Abobor	STM	Science Counterpart	21/8/2000-12/11/2000		★					Miyazaki University	Joined Country-focused group training fully
	Ms. Francesca Haizel	STM	Maths Counterpart	21/8/2000-12/11/2000		★					Miyazaki University	Joined Country-focused group training fully
2001	Mrs. Margaret Benneh	GES TED	Director	16/8/2001-2/9/20001			★				Hiroshima University	Joined Country-focused group training partially
	Mr. Michael Nsowah	GES TED	Deputy Director	13/9/2001-30/9/2001			★				Hiroshima University	Joined Country-focused group training partially
	Mr. Joseph Kweku Asare	AKROTCO	Principal	16/8/2001-2/9/2001			★				Hiroshima University	Joined Country-focused group training partially
	Mr. Jacob Molenaar	STM	Science Counterpart	30/7/2001-4/11/2001			★				Miyazaki University,Shinsyu University	Joined Country-focused group training fully
	Mr. Philip Akoto	STM	Maths Counterpart	30/7/2001-4/11/2001			★				Miyazaki University,Shinsyu University	Joined Country-focused group training fully
2002	Mr. Christian Atiemo	MOE	Chief Director	8/12/2002-22/12/2002							Hiroshima University, JICA	Ms.Lydia Osei(DDG,GES) and Afrani J.Oppong(Director,PBME) joined together sponsored by JICA
	Mr. Adam Zakaria	BATCO	Principal	22/7/2002-22/9/2002				★			Hiroshima University	Joined Country-focused group training partially
	Mr. Stephen Adu	STM	National Coordinator	22/7/2002-22/9/2002				★			Hiroshima University,Tokyo Institute of Technology	Joined Country-focused group training partially
	Mr. Thomas Asuako-Yeboah	AKROTCO	Science tutor,STM Science Coordinator	17/6/2002-28/9/2002				★			Miyazaki University,Shinsyu University	
	Mr. Musah Yakubu	BATCO	Maths tutor,STM Maths Coordinator	17/6/2000-28/7/2002				★			Miyazaki University,Shinsyu University	
	Mr. Francis Kweku Assan	AKROTCO	Maths tutor,STM Maths Coordinator	17/6/2002-20/9/2002				★			Miyazaki University,Shinsyu University	Joined Country-focused group training fully
2003	Mrs.Sopiimeh Yiri-Erong Alexa	Tamale Metropolis	Director	14/8/2003-31/8/2003					★		Hiroshima University	Joined Country-focused group training partially
	Mr.S.K.Okyere	Adansi West District	Director of Education	14/8/2003-31/8/2003					★		Hiroshima University	Joined Country-focused group training partially
	Mrs.Mahama Katsumi	Akuapem North District	Director of Education	14/8/2003-31/8/2003					★		Hiroshima University	Joined Country-focused group training partially
	Ms. Erica Lawson	PTC	Science tutor,STM Science Coordinator	19/6/2003-20/7/2003					★		Miyazaki University,Shinsyu University	
	Mr. Samuel Acquah	PTC	Maths tutor,STM Maths Coordinator	19/6/2003-20/7/2003					★		Miyazaki University,Shinsyu University	

Counterpart Training in Japan and Third Countries as part of the Project

	Name	Organisation	Title	Training Duration	1999(FY)	2000	2001	2002	2003	2004	Training institutions	Remarks
	Mr. John Mahama Baako	BATCO	Vice Principal,Science tutor,STM Science Coordinator	19/6/2003-20/7/2003					★		Miyazaki University,Shinsyu University	
2004	Mr. Henry Clerk	MOEYS	Director of Administration and Finance	27/6/2004-9/7/2004						★	Hiroshima University	
	Mr. Michael Nsowah	GES, HQ	DDG	27/6/2004-9/7/2004						★	Hiroshima University	
	Mr. Emmanuel Aquaye	GES, CRDD	Director	27/6/2004-9/7/2004						★	Hiroshima University	
	Mrs Prudence Gyader	GES, Inspectorate Division	Director	27/6/2004-9/7/2004						★	Hiroshima University	
	Mr. Victor Mante	GES, TED	Deputy Director	27/6/2004-9/7/2004						★	Hiroshima University	
	Rev. Emmanuel Dadebo	MOEYS	ICT Coordinator	27/6/2004-9/7/2004						★	Hiroshima University	
	Mr. Bukari Zacheaus	TATCO	Science tutor	2/2005-							University of Pretoria	

Counterpart Training in Japan and Third Countries Not as part of the Project

	Name	Organisation	Title	Training Duration	1999(FY)	2000	2001	2002	2003	2004	Training institutions	Remarks
Country Focused Training												
1999	Mr. John Budu-Smith	GES	DDG	28/2/2000-12/3/2000		★					Fukuoka University of Education, Hiroshima University	
	Mr. Appiah-Num	MOE	A & F Director	28/2/2000-12/3/2000		★					Ditto	
	Mrs. Elizabeth Adabbor	GES TED	Director	28/2/2000-12/3/2000		★					Ditto	
	Rev. S.K. Mensah	GES, Akuapem North	District Director	28/2/2000-12/3/2000		★					Ditto	
	Mr. Stephen Adu	GES. TED	STM National Coordinator	28/2/2000-12/3/2000		★					Ditto	
	Mr. Emmanuel Gyemera	MOE	Science Resource Centre Coordinator	28/2/2000-12/3/2000		★					Ditto	
	Mr. Osafo-Kantanka	PTC	Vice Principal	28/2/2000-12/3/2000		★					Ditto	
2000	Mr. Amegayie Kofi Divine	PTC	Maths tutor	21/8/2000-15/10/2000		★					Hiroshima University,Fukuoka University of Education	
	Mr. George Ohene	PTC	Science tutor	21/8/2000-15/10/2000		★					Ditto	
	Ms. Amponsah-Baa Sakina	PTC	Science tutor	21/8/2000-15/10/2000		★					Ditto	
	Mr. Abraham Gabriel Koranteng	AKROTCO	Maths tutor	21/8/2000-15/10/2000		★					Ditto	
	Mr. Joseph Kweku Anochie	AKROTCO	Maths tutor	21/8/2000-15/10/2000		★					Ditto	
	Mr. Asuako-Yeboah	AKROTCO	Science tutor,STM Science Coordinator	21/8/2000-15/10/2000		★					Ditto	
	Mr. Musah Yakubu	BATCO	Maths tutor,STM Maths Coordinator	21/8/2000-15/10/2000		★					Ditto	
	Mr. John Baako	BATCO	Vice Principal,Science tutor,STM Science Coordinator	21/8/2000-15/10/2000		★					Ditto	
2001	Mr. Francis Kingsley Tete Odoi	PTC	Science tutor	30/7/2001-30/9/2001			★				Ditto	
	Mr. George Buernortey Appah	PTC	Science tutor	30/7/2001-30/9/2001			★				Ditto	
	Mr. James Boachie Acheampong	AKROTCO	Science tutor	30/7/2001-30/9/2001			★				Ditto	
	Mr. Nicolas Adams Doopilah	BATCO	Science tutor	30/7/2001-30/9/2001			★				Ditto	
	Mr. Emmanuel Afari-Bampoe	PTC	Maths tutor	30/7/2001-30/9/2001			★				Ditto	

Counterpart Training in Japan and Third Countries Not as part of the Project

	Ms. Mary Joycelyn Addo	PTC	Maths tutor	30/7/2001-30/9/2001			★				Ditto		
	Mr. Michael Manu-Antwi	AKROTCO	Maths tutor	30/7/2001-30/9/2001			★				Ditto		
	Mr. Sumani Yakubu	BATCO	Maths tutor	30/7/2001-30/9/2001			★				Ditto		
2002	Mr. Martin Bediako	Akuapem North District	STM District Coordinator	22/7/2002-22/9/2002				★			Ditto		
	Ms. Agbosu Akorfa Akousua	AKROTCO	Science tutor,STM Science Coordinator	22/7/2002-22/9/2002				★			Ditto		
	Mr. Erica Lawson	PTC	Science tutor,STM Science Coordinator	22/7/2002-22/9/2002				★			Ditto		
	Mr. Partick Afulani	BATCO	Science tutor	22/7/2002-22/9/2002				★			Ditto		
	Mr. Samuel Acquah	PTC	Maths tutor,STM Maths Coordinator	22/7/2002-22/9/2002				★			Ditto		
	Mr. Peter Amponsah	AKROTCO	Vice Principal,Maths tutor	22/7/2002-22/9/2002				★			Ditto		
	Mr. Yakubu Abubakar	BATCO	Maths tutor	22/7/2002-22/9/2002				★			Ditto		
	Mr. Humphery Sirikyi	GES, Tamale District Office	STM District Coordinator	22/7/2002-22/9/2002				★			Ditto		
2003	Mr. Ibrahim Kwarteng	PTC	Science tutor	20/7/2003-22/9/2003					★		Ditto		
	Ms. Emma Nsafoah	AKROTCO	Science tutor	20/7/2003-22/9/2003					★		Ditto		
	Mr. Samuel Awuah	Adansi West	STM District Coordinator(AD for Human resource)	20/7/2003-22/9/2003					★		Ditto		
	Mr. Moses Abdulai Abukari	BATCO	Science tutor	20/7/2003-22/9/2003					★		Ditto		
	Mr. Joseph Ghartey-Ampiah	Institute of Education, UCC	Lecturer	20/7/2003-22/9/2003					★		Ditto		
	Mr. Francis Kweku Asare	PTC	Maths tutor	20/7/2003-22/9/2003					★		Ditto		
	Mr. Owusu Gyemera	AKROTCO	Maths tutor	20/7/2003-22/9/2003					★		Ditto		
	Mr. Abdul-Mumin Yussif	BATCO	Maths tutor	20/7/2003-22/9/2003					★		Ditto		
2004	Mrs.Agyemang-Badu Kate	GES, Adansi West District Office	District Pre-school coordinator,DTST member	20/7/2004-19/9/2004						★	Ditto		
	Mr.Ewusi-Yamoah Kobina	GES, Akuapem North District	Curcuit Supervisor	20/7/2004-19/9/2004						★	Ditto		
	Mr. Iddirisu Alhassan Simon	BATCO	Maths tutor	20/7/2004-19/9/2004						★	Ditto		

Counterpart Training in Japan and Third Countries Not as part of the Project

	Mr. Lambon Kwame Jaforktuk	GES, Tamale District Office	Assistant STM District coordinator	20/7/2004-19/9/2004						★	Ditto	
	Mr. Asare Samuel Kobina	AKROTCO	Science tutor	20/7/2004-19/9/2004						★	Ditto	
	Mr.Forkuoh Charles	AKROTCO	Maths tutor	20/7/2004-19/9/2004						★	Ditto	
	Mr. Nyarko Sampson Adi	PTC	Maths tutor	20/7/2004-19/9/2004						★	Ditto	
	Mr. Ahwa Isaac Kwaku	PTC	Science tutor	20/7/2004-19/9/2004						★	Ditto	
Long-term scholarship	Ms.Adu-Yeboah Christine	AKROTCO		4/9/2000-30/9/2002							Hiroshima University	
	Ms.Sakina Amponsah-Baa	PTC	Science tutor	11/2001-10/2003							Naruto University of Education	
	Mr. Davis Ernest	Institute of Education,UCC	Lecturer	9/9/2002-3/10/2004							Hiroshima University	
	Mr. Samuel Kabbah	Peki Training College	Science tutor	25/9/2002-21/3/2005							Naruto University of Education	
	Ms. Josephine Nyarko	St. Monica's Training College	Maths tutor	21/9/2003-25/3/2006							Shinsyu University	
	Mr. Julius Kofi Agbeko	Science Tutor, PTC	Science tutor	24/9/2003-24/3/2006							Naruto University of Education	
	Mr. Sampson T. Damptey	PTC	Technical tutor	1/10/204-							Hiroshima University	
	Mr. Francis Narh	Mount Mary Training College	Maths tutor	1/10/204-							Hiroshima University	
Third country long-term	Mr. E. Bannerman-Wood	PWTC		12/2001-12/2002							National University of Singapore	
Third country short-term	Mr. Vincent Sam Brew	GES, TED		24/2/2002-8/4/2002							SMASSE,Kenya	

ANNEX 3-4 Operating Expenses by JICA

ITEM/FY	1999(From March)	2000	2001	2002	2003	2004	Total	Remarks
Local cost (Daily administration and public relations) (Unit: Thousand Yen)	0	16,524	10,404	12,872	15,502	12,794	68,096	3,257 to support printing harmonized materials in addition to initial plan(2003)
Local cost (Training Activity) (Unit: Thousand Yen)	0	0	11,244	8,289	10,283	9,654	39,470	2,369 to support training activities in addition to initial plan(2003)
Local cost (Others) (Unit: Thousand Yen)	0	8,650	0	0	16,374	10,479	35,503	7,961for Resourcecenter construction in Akropong in 2000 : 16,374 for WECSA conference in 2003
Total (Unit: Thousand Yen)	0	25,174	21,648	21,161	42,159	32,927	143,069	

ANNEX 3-5 List of Counterparts

Name	Organization	Title	1999	2000	2001	2002	2003	2004	Remarks/Training in Japan (indicated by★)(JFY)	Other training
			Start of Project							
Hon.Ameyaw-Akumfi	MOE/MOEYS	Minister								
Hon.Kwadwo Baah-Wiredu	MOE/MOEYS	Minister								
Hon.Rasid Bawa	MOE/MOEYS	Minister of State								
Christian Atiemo	MOE/MOEYS	Chief Director								
Ato Esman	MOE/MOEYS	Chief Director								
Ameyaw-Akumfi	GES HQ	DG							Trained in 2000.He became Minister of Education in 2001.	
John Budu-Smith	GES HQ	Acting DG							Trained in 1999.He was DDG in 2000 and became an acting DG.	
Rev.Amo Afo Bray	GES HQ	DG								
Lydia Osei	GES HQ	DDG							Trained in 2002	WECSA conference in Kenya 2002 and Sotuh
Michael Nsowah	GES HQ	DDG							Trained in 2004	
Elizabeth Addobor	Teacher Education Divisin	Director								
Margarete Benneh	Teacher Education Divisin	Director								
Michael Nsowah	Teacher Education Divisin	Deputy Director							He was Principal at AKROTCO before 2000 and became Deputy Director.	
Victor Mante	Teacher Education Divisin	Deputy Director							He was at TED all through and became Deputy Director in 2004	
Stephen Adu	STM Project	National Coordinator								WECSA conference in Kenya 2001,2002 and Sotuh Africa

ANNEX 3-5 List of Counterparts

Name	Organization	Title	1999	2000	2001	2002	2003	2004	Remarks/Training in Japan (indicated by ★)(JFY)	Other training
Rosina Adobor	STM Project	Science Counterpart		★						Technical exchange visit to Kenya in 2001,South
J.W.Molennar	STM Project	Science Counterpart			★					Technical exchange visit to Kenya in 2001,South
Francesca Haizel	STM Project	Mathematics Counterpart		★						Technical exchange visit to Kenya in 2001,South
P.N.Apesemah	STM Project	Mathematics Counterpart								Left in 2001
P.V.Akoto	STM Project	Mathematics Counterpart			★					Technical exchange visit to Kenya in 2001,South
S.K.Mensah	Akuapem North District	District Director of Education	★						Trained in 1999.He became Director of Education after Principal PTC.	
Hajima Katsumi	Akuapem North District	District Director of Education					★		Trained in 2003	
M.Bediako	Akuapem North District	STM Coordinator				★			Trained in 2002	
S.K.Mensah	PTC	Principal							Trained in 1999	
Osei K. Emmanuel	PTC	Principal			★				Trained in 2001	
Kantanka Osafo-Begyabeng	PTC	Vice Principal	★							
Acquah Samuel	PTC	Maths tutor,STM Maths Coordinator				★	★		Trained in 2002/2003	
Amegayie Divine Kofi	PTC	Maths tutor		★					Trained in 2000	
Asare Francis Martey	PTC	Maths tutor					★		Trained in 2003	
Addo Mary Joycelyn	PTC	Maths tutor			★				Trained in 2001	
Bampoe Afari	PTC	Maths tutor			★				Trained in 2001	
Adi Nyarko Sam	PTC	Maths tutor						★	Trained in 2004	

ANNEX 3-5 List of Counterparts

Name	Organization	Title	1999	2000	2001	2002	2003	2004	Remarks/Training in Japan (indicated by★)(JFY)	Other training
Erica Lawson	PTC	Science tutor				★	★		Trained in 2002/2003	
Appah George B	PTC	Science tutor			★				Trained in 2001	
Odoi Francis K.T	PTC	Science tutor			★				Trained in 2001	
Ohene George	PTC	Science tutor		★					Trained in 2000	
Kwanteng Ibrahim	PTC	Science tutor					★		Trained in 2003	
Awah Isaac	PTC	Science tutor						★	Trained in 2004	
Amponsah-Baa Sakina	PTC	Science tutor		★					Trained in 2000.Long-term scholarsip(2002-2004)	
Okyere S. K.	District	Director					★		Trained in 2003	
Awuah Samuel A.B.	District	A.D. Human Resources					★		Trained in 2003	
Kate Agyeman-Badu	District	A.D. ECCD, DHA DMIT, STM						★	She went for further study and came back.Trained in 2004	
Joseph Kweku Asare	AKROTCO	Principal			★				Trained in 2002	
Assan Francis	AKROTCO	Maths tutor				★			Trained in 2002	
Anochie Joseph	AKROTCO	Maths tutor		★					Trained in 2000	
Owusu Gyambera	AKROTCO	Maths tutor					★		Trained in 2003	
Koranteng Gabriel	AKROTCO	Maths tutor			★				Trained in 2001	
Manu-Antwi Michael	AKROTCO	Maths tutor				★			Trained in 2002	
Amponsah Peter	AKROTCO	Vice Principal, Maths				★			Trained in 2002	
Forkuoh Charles	AKROTCO	Maths tutor						★	Trained in 2004	
Thomas Asuako-Yeboah	AKROTCO	Science tutor,STM Science coordinator		★		★			Trained in 2000/2002.Left AKOTCO in 2003	

ANNEX 3-5 List of Counterparts

Name	Organization	Title	1999	2000	2001	2002	2003	2004	Remarks/Training in Japan (indicated by★)(JFY)	Other training
Achampong Boachie	AKROTCO	Science tutor			★				Trained in 2001	
Agbosu Akofa	AKROTCO	Science tutor,STM Science coordinator				★			Trained in 2002	
Emma Nsafoa Baiden	AKROTCO	Science tutor					★		Trained in 2003	
Asare Samuel	AKROTCO	Science tutor						★	Trained in 2004	
Gaa Jatoe	District	Director of Education								
Sopiimeh Alexandria	District	Director of Education					★		Trained in 2003	
Sirikyi Humphrey	District	STM Coordinator				★			Trained in 2002	
Adams Zakaria	BATCO	Principal				★			Trained in 2002	
Musah Yakubu	BATCO	Head of Department, Maths				★	★		Trained in 2002/2003	
Sumani Yakubu	BATCO	Maths tutor			★				Trained in 2001	
Abubakar Yakubu	BATCO	Maths tutor				★			Trained in 2002	
Yussif A. Mumin	BATCO	Maths tutor					★		Trained in 2003	
Simon A.Iddrisu	BATCO	Maths tutor						★	Trained in 2004	
Amankwa Amidu	BATCO	Maths tutor								
Baako John Mahama	BATCO	Vice Principal/Science tutor		★			★		Trained in 2000/2003	
Doopila Nicholas	BATCO	Science tutor			★				Trained in 2001	
Afulani Patrick	BATCO	Science tutor				★			Trained in 2002	
Abukari Moses Abudullai	BATCO	Science tutor					★		Trained in 2003	
Iddi Mahama	TATCO	Maths tutor								

ANNEX 3-5 List of Counterparts

Name	Organization	Title	1999	2000	2001	2002	2003	2004	Remarks/Training in Japan (indicated by★)(JFY)	Other training
Abdul-Rahaman Issahaku	TATCO	Maths tutor								
Osei Yaw Nana	TATCO	Maths tutor								
Imoro Nuhu Alhassan	TATCO	Maths tutor								
Bukari Zacchaeus	TATCO	Science tutor								
Imoro A. Wahab	TATCO	Science tutor								

ANNEX 3-6 Inputs from Ghanaian Government

ITEM/FY	1999(From March)	2000	2001	2002	2003	2004(Estimated)	Total	Remarks
Facilities provision/renovation (Unit :cedis)	0	79,777,600	0	0	2,201,605,978	0	2,281,383,578	Road construction at PTC(706,904,652 cedis),Tamale Seminar Room at BATCO(419,074,582 cedis),Teachers' bangaloo at PTC,BATCO,AKROTCO(Total 1,075,626,744 cedis) Conference room renovation at Teacher Education Division
Running cost from GOG (Unit :cedis)	-	-	-	-	-	26,000,000	26,000,000	Electlicity at Accra office beared by TED.Headteacher seminar(1.5 million on average) sponsored by District office at Akuapem North in 2000 and Tamale in 2004. 23 million spent by TED for National workshop in 2004
Counter-value fund(INSET related activities) (Unit :cedis)	0	0	0	0	303,750,000	6,864,000,000	7,167,750,000	Estimated input for 2004 includes both 2004 and 2005.

4. Data analysis on impact monitoring of INSET, questionnaires, interviews and students' achievement tests

GES-JICA SCIENCE, TECHNOLOGY AND MATHEMATICS (STM) PROJECT

DATA ANALYSIS ON IMPACT MONITORING OF INSET, QUESTIONNAIRES, INTERVIEWS AND PUPILS' ACHIEVEMENT TESTS

OCTOBER, 2004

By

Teacher Education Division, Ghana Education Service
Japan International Cooperation Agency
and
Institute of Education, University of Cape Coast

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List of Abbreviations and Acronyms

fCUBE	Free Compulsory Universal Basic Education
GES	Ghana Education Service
INSET	In-Service Training
JICA	Japan International Cooperation Agency
JSS	Junior Secondary School
MOE	Ministry of Education
PDM	Project Design Matrix
PMT	Performance Monitoring Test
STM	Science Technology and Mathematics
TIMSS	Trends in Mathematics and Science Survey
TLMs	Teaching Learning Materials
TTCs	Teacher Training Colleges

EXECUTIVE SUMMARY

Background

In view of the critical role science and technology play in the economic and industrial development of every nation, the Republic of Ghana is committed to ensuring that sound scientific policies and programmes are put in place as a prerequisite for national development. It is in view of this that the Ministry of Education and the Ghana Education Service, under the Free Compulsory Universal Basic Education (FCUBE) placed emphasis on the teaching and learning of science, technology and mathematics in basic schools.

Ghana acknowledges the high premium Japan places on science, technology and mathematics which has accounted for the development in Japan. In this respect the Government of Ghana proposed for assistance from the Government of Japan which resulted in the Project Type Technical Cooperation. Japan International Cooperation Agency (JICA) on behalf of the Government of Japan initially dispatched survey teams for further discussions with the Government of Ghana through the Ministry of Education and the Ghana Education Service on the proposed project in 1997. As a result of the discussions, the two Governments agreed to undertake the Project referred to as "Science, Technology and Mathematics (STM) Project". It was piloted through a structured in-service training programme in three out of the one hundred and ten districts in the country. The implementation of the Project started in March 2000 and will end in February 2005.

The governments of Ghana and Japan through the Ghana Education Service (GES) and JICA respectively, initiated the STM project in March 2000. The main aim of the GES-JICA STM project was to improve the teaching and learning of science and mathematics at upper primary and Junior Secondary School (JSS) levels within the project areas. The project areas are Adansi West District and Akuapem North District and Tamale District.

To achieve its objectives, the GES-JICA STM Project set out to improve the capacity of basic school teachers in both content and methodology in science and mathematics as a way of equipping the teachers with the necessary skills for effective delivery of science and mathematics lessons for upper primary and JSS pupils in the three project districts. This constituted the main thrust of the GES-JICA Project. The ultimate goal of the project was to enhance basic school science and mathematics teachers' instructional competence so that it impacts significantly on pupils' achievement starting with the project districts.

Using evidence obtained through a baseline and midterm surveys, the project determined key areas in the teaching and learning of science and mathematics that required INSET intervention. The underlying assumption was that as teachers' knowledge and teaching skills improved, especially in their ability to use local materials in teaching, it will demystify science and mathematics, promote pupils' interest and lead to significant improvements in their performance.

Objective of Final Evaluation of STM Project

The STM project organised INSET to enable teachers improve their lesson planning, preparation and use of TLMs and instructional skills. The objective of the final evaluation of the STM project was to ascertain and confirm the achievements of the project goals of improving the capacity of teachers for STM delivery and the improvement of pupils' achievement levels in science and mathematics at the upper primary and JSS levels. The final survey therefore evaluated the project by focusing on the impact of INSET activities

organised for teachers and subsequent impact on pupils' achievements in science and mathematics.

Summary of Key Findings

Impact of STM INSET

1. Assessment of upper primary and JSS STM trained teachers by external assessors showed a marked improvement in the writing of lesson notes in all seven areas assessed after the teachers had gone through STM INSET. Changes in scores before and after INSET were highest in the area of TLMs.
2. Assessment of upper primary and JSS STM trained teachers by external assessors showed a marked improvement in lesson presentation in all five areas assessed after the teachers had gone through STM INSET. Changes in scores before and after INSET were highest in the area of TLMs and introduction of lessons. Also Circuit Supervisors, headteachers and STM trained teachers were unanimous in asserting that the impact of the STM INSET has brought about marked improvement in the writing of lesson notes, presentation of lessons and the use of TLMs.
3. Giving of exercises in science and mathematics to pupils has improved after teachers went for the STM INSET.
4. Pupils have developed more interest in science and mathematics as a result of changes in instructional delivery and see the subjects as useful.

Performance of pupils in science and mathematics

1. Overall the performance of pupils in upper primary and JSS in the final evaluation survey in mathematics and science was better than in the mid-term baseline survey
2. The results of the survey show that generally, primary and JSS pupils made improvements in achievement as they moved to higher grade levels.
3. There were significant differences in the level of achievement in the three districts. Generally at both upper primary and JSS, pupils in Akuapem North District performed better in the science and mathematics achievement tests than pupils in Tamale and Adansi West Districts in that order.
4. The same cohort of pupils (P4/P5, P5/P6 and JSS1/JSS2) who took the mid-term baseline recorded significant gains in their performance in the final evaluation achievement tests in science and mathematics.
5. Upper primary and JSS level males pupils performed better than their female counterparts in both science and mathematics achievement tests in the final evaluation survey
6. There was a moderate to strong linear correlation between performance in English language and science, English language and mathematics, and science and mathematics at both primary and JSS levels. This means that performance in English language has a positive linear relationship with performance in mathematics and science and also performance in science has a positive linear relationship with performance in mathematics.

Achievement of PDM targets science and mathematics

1. The project was able to achieve the PDM target of 45.0% of upper primary pupils obtaining 36.0% in science achievement test. The target for the mathematics achievement test was not achieved.

2. The project was able to achieve the PDM target of 40.0% of JSS pupils achieving 36.0% in mathematics achievement test. The target for the science achievement test was not achieved.

Comparison of mid-term baseline and final evaluation survey in the same TIMSS questions

1. There was a significant improvement in performance of upper primary pupils in the TIMSS questions in science but not in mathematics in the final evaluation survey compared to the mid-term baseline survey. However, mean scores in both science and mathematics were less than half the total scores.
2. There was a significant improvement in performance of JSS pupils in the TIMSS questions in science and mathematics in the final evaluation survey compared to survey.

Conclusion

The key findings of this final evaluation survey leave little doubt that the GES-JICA STM Project has had tremendous impact on upper primary and JSS teachers who participated in the STM INSET. Findings of the survey have shown considerable improvement in lesson notes preparation, lesson presentation and development and use of teaching and learning materials. To a large extent therefore the project has achieved its purpose of improving the capacity of STM/INSET-trained teachers for delivering STM in the three project areas.

Also the short term goal of the GES-JICA STM Project improving the educational achievement of pupils at upper primary and JSS in science and mathematics were achieved in science for upper primary pupils and in mathematics by JSS pupils.

Suggestions/Way Forward

(a) To sustain the impact of the STM project, districts should be adequately resourced in terms of funding and human resources to enable to support continuous structured INSET at both district and school levels. It is important to note that teachers will go back to the familiar traditional approaches to the teaching of science and mathematics if the good practices introduced by the STM project are not given adequate support particularly at the school level to consolidate the skills acquired by teachers. To be able to do this, it is important for more effort and time to be invested at the school level by the GES to support teachers. Initially, teachers may lack the confidence and authority to be resource persons at school level INSET particularly for younger staff. It is therefore important that more capable and resourceful STM trained teachers are identified and supported to facilitate school-based INSET at the school level for them to gain experience. There is also the need for greater collaboration between headteachers, circuit supervisors, district officers and TTCs in support of the STM trained teachers. This will help to sustain the good practices of STM project.

(b) The good practices teachers had acquired require a culture of teaching and learning that allow for more time on task by pupils in order to develop the appropriate concepts. However, this raises the problem of teachers' complaints of having to teach several different lessons especially in the upper primary school. Teachers' workload therefore becomes an issue that is likely to affect effective instructional delivery. This will make it difficult to implement fully the new strategies and skills for teaching which are child-centred and activity oriented. One way of dealing with this problem as suggested by some

teachers is to introduce subject teaching for science and mathematics particularly at the upper primary school.

(c) One of the key successes of the STM INSET has been the development and use of TLMs. However, there is some cost element involved in the extensive use of TLMs for lessons in science and mathematics. Also even though teachers can improvise some items through the use of available materials from their surroundings, some materials for improvisation must be purchased (e.g. cardboards, felt pens, magnets, measuring cylinders etc). Some improvised materials also have a shorter life span and may need to be replaced as often as possible. Schools may therefore need science and mathematics kit boxes to be supplied by the MOE to both primary schools and JSS and replenished from time to time.

(d) The study showed that boys performed better than girls in both science and mathematics. Therefore the need for explore through INSET teaching methodologies which could address this imbalance.

(e) The University of Cape Coast and the University of Education, Winneba must be encouraged to lend support in the facilitation of INSET for basic school teachers due to their expertise in the training of basic school teachers.

1.0 Introduction

1.1 Background

In view of the critical role science and technology play in the economic and industrial development of every nation, the Republic of Ghana is committed to ensuring that sound scientific policies and programmes are put in place as a prerequisite for national development. It is in view of this that the Ministry of Education and the Ghana Education Service, under the Free Compulsory Universal Basic Education (FCUBE) placed emphasis on the teaching and learning of science, technology and mathematics in basic schools.

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The governments of Ghana and Japan through the Ghana Education Service (GES) and JICA respectively, initiated the STM project in March 2000. The main aim of the GES-JICA STM project was to improve the teaching and learning of science and mathematics at upper primary and Junior Secondary School (JSS) levels within the project areas. The project areas are Adansi West District and Akuapem North District and Tamale District.

To achieve its objectives, the GES-JICA STM Project set out to improve the capacity of basic school teachers in both content and methodology in science and mathematics as a way of equipping the teachers with the necessary skills for effective delivery of science and mathematics lessons for upper primary and JSS pupils in the three project districts. This constituted the main thrust of the GES-JICA Project. The ultimate goal of the project was to enhance basic school science and mathematics teachers' instructional competence so that it impacts significantly on pupils' achievement starting with the project districts.

Using evidence obtained through a baseline, the project determined key areas in the teaching and learning of science and mathematics that required INSET intervention. The underlying assumption was that as teachers' knowledge and teaching skills improved, especially in their ability to use local materials in teaching, it will demystify science and mathematics, promote pupils' interest and lead to significant improvements in their performance.

1.2 Objective of Final Evaluation of STM Project

The STM project organised INSET to enable teachers improve their lesson planning, preparation and use of TLMs and instructional skills. The objective of the final evaluation of the STM project was to ascertain and confirm the achievements of the project goals of improving the capacity of teachers for STM delivery and the improvement of pupils' achievement levels in science and mathematics at the upper primary and JSS levels. The final survey therefore evaluated the project by focusing on the impact of INSET activities

organised for teachers and subsequent impact on pupils' achievements in mathematics and science.

1.3 Specific Questions for the STM Final Evaluation

The research questions for the final evaluation of the GES-JICA STM project were as follows:

1. What is the impact of STM INSET on teacher performance in the following areas:
   (a) Preparation of lesson notes
   (b) Presentation of lesson
   (c) Preparation and use of TLMs.
2. What is the performance of pupils in science and mathematics by district, class and gender?
3. What percentage of pupils achieved the STM project's PDM targets at the end of year five in science and mathematics by district and class?
4. Is there any correlation between the performance of pupils in science, mathematics and English Language?
5. What is the comparison between the same TIMSS questions for mid-term baseline and final evaluation achievement test?

1.4 Research Design and Methodology

1.4.1 Sample

The Final Evaluation targeted all STM trained teachers, all headteachers and circuit supervisors in the three districts as well as science and mathematics tutors of the three Teacher Training Colleges (TTCs) involved in the project.

Data was also collected from nine upper primary schools and nine JSS in Akuapem North District, and six upper primary schools and six JSS in each of the other two districts (Adansi West District and Tamale Districts). The selection of the schools cut across average, above average and below average schools as determined by their respective district directorate based on Performance Monitoring Test (PMT) and Basic Education Certificate Examination (BECE) results. As indicated in Table 1, in the Akuapem North District, three of the schools were classified as above average, three as average and three as below average, while in Adansi West District two schools each were in these same categories. In Tamale District, two of the schools were classified as above average, three as average and one as below average.

Table 1: Distribution of Sample Schools for Final Evaluation

District	Primary Schools				JSS Schools				Grand Total
	Ave.	Above Ave.	Below Ave.	Total	Ave.	Above Ave.	Below Ave.	Total	
Akuapem North	3	3	3	9	3	3	3	9	18
Tamale	3	2	1	6	2	2	2	6	12
Adansi West	2	2	2	6	2	2	2	6	12
Total	8	7	6	21	7	7	7	21	42

1.4.2 Design and Administration

The final evaluation of the STM project was carried out between 21st June and July 16th, 2004 in the three districts involved in the project.

Questionnaires, interviews, tests and observation schedules were designed and employed in the survey to collect both qualitative and quantitative evidence. The instruments used for the survey were:

Target Groups		Methods	Implementation (*)			
			Baseline 2000	Mid-term 2002	Mid-term Baseline 2003	Final Evaluation 2004
TTC	Students	Questionnaire	*			
	Science and Maths tutors	Questionnaire	*			*
		Focus-Group Interview				*
	Teaching Practice Coordinators	Interview	*			
Basic Schools	Headteachers	Questionnaire		*		*
		Interview				*
	Teachers	Questionnaire	*	*		*
		Lesson Observation	*	*		*
		Interview	*	*		
		Focus-Group Interview				*
	Pupils/ Students	Achievement Test	*	*	*	*
		Interview	*	*		*
	Parents/Guardian	Interview	*	*		
District	Circuit Supervisor/ Officials	Focus-Group Interview				*
		Questionnaire				*

Two days were spent in each school for data collection. The first day was devoted to the administration of the achievement tests and the second day for the interview of the headteacher, STM trained teachers and the six pupils in each class.

1. Questionnaires

Questionnaires were administered to STM trained teachers, Headteachers, Circuit Supervisors, and TTC Science and Mathematics tutors in order to collect their views and impressions about the STM Project, including the impact of the Project.

The questionnaire for STM trained teachers was administered to all 1720 teachers who participated in the STM INSET on the first day of the six-day INSET. For the Final Evaluation, the same questionnaire was distributed to STM trained teachers who were at post during the survey. In all 954 questionnaires were collected, out of which 430 questionnaires were used for comparison between Pre-INSET scores and Post-INSET scores of the same teachers.

Table 2: No. of Questionnaire for STM trained teachers collected and analysed

District	No. of Questionnaires collected			No. of Questionnaires analysed		
	Prim	JSS	Total	Prim	JSS	Total
Akuapem North	228	99	327	105	46	151
Tamale	294	104	398	165	48	213
Adansi West	154	75	229	41	25	66
Total	676	278	954	311	119	430

Table 3 :Distribution of data collection and analysis

Target groups		Instruments	Akuapem North			Tamale			Adansi West			Grand Total			Remarks
			Prim	JSS	Total	Prim	JSS	Total	Prim	JSS	Total	Prim	JSS	Total	
Basic Schools	Headteacher	Questionnaire	86 /117	44 /59	130 /176	186 /230	58 /64	244 /294	101 /115	39 /63	140 /178	357 /457	166 /179	523 /636	No. collected and analyzed /Total No. of headteachers
		Interview	9	9	18	6	6	12	6	6	12	21	21	42	No. collected and analyzed
	Teachers	Questionnaire	228 /534	99 /253	327 /787	294 /474	104 /140	398 /614	154 /217	75 /102	229 /319	676 /1225	278 /495	954 /1720	No. collected /Total No. of STM trained teachers
		Lesson Observation	23	7	30	24	18	42	13	9	22	60	34	94	No. monitored
		Focus Group Interview	9 (27)	9 (23)	18 (50)	6 (18)	6 (16)	12 (34)	6 (14)	6 (7)	12 (21)	21 (59)	21 (46)	42 (105)	No. of groups (No. of teachers)
	Pupils/ Students	Achievement Test	838	595	1433	820	430	1250	604	527	1131	2262	1552	3814	No. of pupils
		Interview	162	108	270	108	72	180	108	72	180	378	252	630	No. of participants
District	Circuit Supervisor/ Officials	Questionnaire	4 /9			9 /15			9 /9			22 /33			No. collected and analyzed / Total No. of circuit supervisors
		Focus Group Interview	1 (9)			1 (8)			1 (7)			3 (24)			No. of groups (No. of participants)
TTC	Science and Maths tutors	Questionnaire	9 /12 (7Sci,5Maths) (9Male,3Female)			8 /10(4Sci,6Maths) (10Male,0Female)			7 /11 (4Sci,7Maths) (7Male,4Female)			24 /33 (15Sci,18Maths) (26Male,7Female)			No. collected and analyzed /Total No. of TTC tutors (Science, Maths) (Male, Female)
		Focus Group Interview	1 (12(7Sci, 5Maths), (9Male, 3Female))			1 (11(4 Sci,7Maths), (9M,2Female))			1 (10 (4 Sci,6Maths), (10Male,0Female))			3 (33 (15 Sci,18Maths), (28Male,5Female))			No. collected and analyzed (No. of participants (Science, Maths), (Male, Female))

As indicated in Table 3, data was collected from 523 headteachers (i.e. 140 from Adansi West, 130 from Akuapem North and 253 from Tamale), 22 circuit supervisors (four from Akuapem North and nine each from Adansi West and Tamale Districts) as well as 24 science and mathematics tutors from the three Teacher Training Colleges involved in the STM project. These were made up of eight teachers each from Akrokerri Training College, PTC, Akropong, and Bagabaga Training College).

2. Interviews

All the headteachers of the schools that participated in the achievement tests were interviewed. Six pupils from each class made up of three boys and three girls, who were classified as above average, average and below average, were interviewed. In all, 630 pupils made up of 378 from the upper primary school and 252 from the JSS students were interviewed.

3. Focus-group interviews

Focus group interviews were conducted with the STM trained teachers in the schools which participated in the survey, circuit supervisors and science and mathematics tutors of the three Teacher Training Colleges in the project areas.

4. Achievement Test

The tests used for the final evaluation survey were the same as those employed during the mid-term baseline survey. The items were developed based on various topics in the syllabuses of both upper primary and JSS. The test items also included questions from Trends in Mathematics and Science Survey (TIMSS). Items based on the upper primary and JSS syllabuses used in the schools and issued by the Ministry of Education (MOE) were used to test mainly recall and understanding levels of Blooms taxonomy whilst the TIMSS questions tested mainly application of concepts. The English language test was based on a representative sample of items from lower primary English language (in the case of upper primary achievement test) and upper primary English language curricula (in the case of JSS1 and JSS2).

In each selected school and class, the mathematics test was administered first followed by the science test and then the English language comprehension test. Pupils in P4 to P6 took the same tests in mathematics, science and English language. The JSS1 and JSS2 pupils also took the same tests with a higher level of difficulty than the upper primary tests. Primary mathematics and science tests were to be answered within 40 minutes, while JSS mathematics and science tests were 60 minutes. The English language comprehension tests were to be answered within 45 minutes by both upper primary and JSS pupils. Each achievement test was preceded by a practice test that was to enable pupils familiarise themselves with the structure and form of the tests. During the practice tests, pupils were helped to understand the way in which the tests were to be answered.

The English language comprehension tests for both upper primary and JSS comprised two sections The English language comprehension test items were designed in such a way that in upper primary (P4, P5 & P6) pupils would demonstrate the attainment of lower primary English language in order to comprehend the passages, while the JSS1 and JSS2 passages were designed in such a way that pupils in the JSS would have attained competencies of upper primary school English language to comprehend the passages.

In all, 21 upper primary schools and 21 JSS participated in the survey. This was made up of 2262 upper primary school pupils and 1552 JSS pupils. Achievement tests were taken by upper primary and JSS1 and JSS2 pupils and all the 2262 pupils from the upper primary school and 1552 pupils from the JSS participated in Mathematics, Science and English language.

Table 4: Distribution of upper primary and JSS pupils who took mathematics, science and English Language tests by gender

Districts	Gender	Primary		JSS	
		No	%	No	%
Akuapem North	Female	399	47.6	303	50.9
	Male	439	52.4	292	49.1
	Total	838	100.0	595	100.0
Tamale	Female	407	49.6	176	40.9
	Male	413	50.4	254	59.1
	Total	820	100.0	430	100.0
Adansi West	Female	327	54.1	232	44.0
	Male	277	45.9	295	56.0
	Total	604	100.0	527	100.0
GRAND TOTAL	Female	1133	50.1	711	45.8
	Male	1129	49.9	841	54.2
	Total	2262	100.0	1552	100.0

5. Assessment for lesson notes and lesson presentation

Before the STM training, some of upper primary and JSS teachers in all the three project districts were observed by TTC tutors, Japanese mathematics and science experts and their counterparts in Ghana. Lesson notes and lesson presentations of the teachers in science and mathematics were assessed by using lesson note and lesson presentation assessment criteria developed and validated by the STM project. After the teachers had participated in the STM INSET, they were assessed again by the same assessors about one to three months later. Scores obtained by the same teachers in the pre and post assessments were recorded.

As indicated in Table 5, 94 STM trained teachers were monitored through stratified sampling techniques mainly based on circuits where the teachers were teaching in the districts for the pre and post monitoring for the lesson observation.

Table 5: Number of STM trained teachers who were monitored

District	Primary			JSS			Grand Total
	Science	Maths	Total	Science	Maths	Total	
Akuapem North	12	11	23	3	4	7	30
Tamale	14	10	24	9	9	18	42
Adansi West	6	7	13	5	4	9	22
Total	32	28	60	17	17	34	94

1.5 Structure of the Report

The final evaluation report consists of seven parts. The introductory section provides the relevant background information about the goals of GES-JICA STM Project. It discusses the main purpose of the evaluation and the research design and methodology. The second part is a summary review of key findings and issues that emerged from the baseline, mid-term, and mid-term baseline surveys and their implications for the project as a whole. Attempt is made to highlight the significant achievements and challenges that were noted in those surveys. The rationale is to provide a basis for conducting the final evaluation of the project after the successes and challenges have been pointed out in previous reviews. The third section presents an overview of the activities of the STM project as a whole, and also interventions and activities which were put in place in response to the challenges and problems which came up during the previous evaluations of the project. Findings from the final evaluation of the project and discussions of the findings are presented in Section 4. Emphasis is placed on the impact of STM INSET on teachers' performance and pupils' achievement in science and mathematics. It also includes analysis of the data used in the final evaluation and other project related documents. Section five gives a summary of the key findings of the final evaluation of the GES-JICA STM project. Essentially the final evaluation of the project is to confirm the achievement of project goals in respect of projections set out in the STM Project Design Matrix (PDM). The last but one section draws together the emerging findings to conclude on the successes and challenges of the project. In section seven suggestions for the way forward for science and mathematics education in basic schools in Ghana.

2.0 Review of Key Issues Emerging from Baseline, Midterm Review and Mid-term Baseline

2.1 Introduction

This section provides a summary review of the key findings of the baseline, mid-term and mid-term baseline surveys. The main purpose of this review is to highlight the evidence and conclusions drawn from the previous evaluation surveys in order to see those which had been addressed and those which had persisted since the last review of the project. This will enable the progress made to be seen clearly and to weigh them against the outcomes of the final evaluation survey in order to infer further gains (or otherwise) made since the baseline mid-term review.

2.2 Methodology

The baseline survey employed a variety of research approaches. It used both qualitative and quantitative evidence to draw conclusions about the status of teaching and learning of science and mathematics, and the achievement levels of pupils. Tests were developed based on the upper primary and JSS1-3 Science and Maths syllabuses. Questionnaires were administered to Teacher Training College (TTC) tutors, final year students in the TTCs majoring in science or mathematics. Also teaching practice coordinators were interviewed for their views on issues regarding teaching practice.

In the Mid-Term Review, TTCs were not included in the survey since the objective was to evaluate the project at its point of final impact in terms of school level performance and the strategies that might have contributed to its impact at the time. The science and mathematics questions were changed from multiple choice and short answer type questions to solely multiple choice questions. The Mid-Term Review recommended that the sample size of schools involved in the achievement tests should be increased to allow for a larger sample in the survey and also a test in English language should be conducted to find out whether the mastery of English language has an influence on achievement in science, since the science achievement tests required the reading and understanding of far more text than the mathematics test.

Following these recommendations at the Mid-Term Review, a second baseline survey called the mid-term baseline survey was conducted in June 2003. More schools were selected from the Akuapem North District because more teachers from the district as at that time had benefited from STM in-service training programmes than the other two districts. The number of schools participating in the achievement tests was therefore increased from nine upper primary schools and nine JSS to 21 upper primary schools and 21 JSS in the all three districts. English test was administered in addition to science and mathematics achievement tests to see correlation of performance in Science and English.

2.3 Key Findings and Issues from Previous Surveys

The following are the key findings and issues relevant to the final evaluation survey which emerged from the various surveys.

2.3.1 Baseline

1. The levels of achievement in mathematics for both upper primary and JSS pupils were very low

2. Teachers valued interactive approaches in improving the performance of pupils. However, well over half of them put a premium on memorisation of basic knowledge, formulas and procedures as a strategy for pupils to improve on their performance.

3. Whole class teaching was the predominant teaching strategy adopted in the teaching of science and mathematics.

4. Teachers blamed their lack of practical skills and wide variations in pupils' abilities among other things as the major factors that constrained their teaching efforts.

The key findings in the baseline study revealed that pupil-centred instructional methods and problem solving did not feature in teachers' teaching strategies. Also the performance of pupils in science and mathematics were very low and could be attributed in part to the absence of effective instructional methods. The challenge for the STM project therefore was how it was going to make teachers adopt more effective approaches to teaching different from what teachers were using and which could result in higher pupils' achievement.

2.3.2 Mid-term Review

1. Upper primary and JSS teachers had a positive perception of the STM INSET. They felt that it had contributed immensely towards positive approaches to teaching mathematics and science through the use of hands-on learning activities and the development and use of TLMs.
2. In the mid-term test only P6 and JSS2 pupils performed better in both mathematics and science than their counterparts in the baseline test. P5, P6 and JSS2 pupils performed better in mathematics compared to their counterparts in the baseline test.
3. The results of the mid-term review show that generally, upper primary and JSS pupils made improvements in science and mathematics achievement as they moved to the next higher grade level. However, the quality of the improvement was unsatisfactory judging from the mean score differences across grade levels especially at the upper primary level.

The pupils involved in the midterm survey appear to be weaker compared to those who took part in the baseline survey. It was suggested after the mid term survey that the most important lesson about STM INSET was that even though teachers claimed it had enhanced their understanding of effective teaching of mathematics and science, it had not yet translated into improvement in pupils' performance in science and mathematics. Teachers were therefore to be supported to put the experiences at the INSET into practice at the classroom level. Also the report recommended that the STM project was tasked by the report to pay attention to school-based INSET and support for teachers to deliver at the classroom level.

2.3.3 Mid-term Baseline

1. The general performance of pupils in the mathematics achievement test at both the upper primary and JSS levels were better than the performance of pupils in the midterm survey. However, the same cannot be said for science.

2. The levels of achievement in English language for both upper primary and JSS pupils were very low especially for upper primary school pupils.
3. The results of the mid-term baseline survey show that upper primary and JSS pupils made improvements in mathematics and science achievement tests as they move to the next higher grade.

4. There was a moderate to strong linear correlation between performance in English language and science at both upper primary and JSS levels. This suggested that comprehension of science achievement test items was critical for performing well in science.

Achievement levels of upper primary and JSS pupils in mathematics and science at the baseline and midterm tests were not significantly different particularly for science. Even though at the time of the mid-term survey, teachers had started receiving INSET from the STM project, it had not led to the desired improvement in pupils' performance in science and mathematics.

Since the mathematics and science questions used in the mid-term baseline survey were different from those of the baseline and mid-term surveys, a comparison in performance of the pupils cannot be made between the mid-term baseline and the two previous surveys. Comparison will therefore be made between pupils' achievement in mathematics and science in the mid-term baseline and final evaluation tests.

3.0 Overview of Activities carried out by STM Project from March 2000 to July 2004

The STM Project is aimed at improving educational achievement in science, technology and mathematics in Basic Education.

The purpose of the project is to improve the capacity of teachers in the teaching of Science, Technology and Mathematics in Basic Schools.

3.0.1 Scope and Structure of Project Implementation

a) Subject: Mathematics and Science (Integrated Science and General Science)
b) Level: Upper primary Grade 4, 5 & 6 and JSS Grade 1, 2 and 3)
c) Programme Unit (PU) set up at the Teacher Education Division
d) Project areas
    I. Akuapem North District
    II. Adansi West District and
    III. Tamale District
e) Teacher Development Centres
    I. Presbyterian Training College, Akropong
    II. Akrokerri Training College, Akrokerri
    III. Bagabaga Training College, Tamale

3.0.2 6-day INSET

The training of teachers in the Akuapem North district began in 2001 after one year of intensive preparation for the INSET. The INSET structure was replicated in the Tamale District in February 2002 and Adansi West District in October 2002.

Until Feb 2002, the selection of teachers for the STM INSET in Akuapem North district was restricted to those teaching in Primary 5 for mathematics and Primary 6 for science, and JSS mathematics and science teachers. The implication is that in every primary school in the Akuapem North district as at Feb 2002, each school had at least two teachers trained by STM, one for mathematics (P5) and the other for science (P6), and in the JSS at least one each for science and mathematics.

After Feb 2002, the training for Primary 4 teachers in Akuapem North district started. In this case a school had the option to select a teacher for either mathematics or science. This arrangement was coordinated by the district. This then brought the number of teachers trained in each primary school in the Akuapem North district to at least 3. This approach was replicated in Tamale in February 2002. As at now, at least two teachers from each school in the Tamale District have received STM training.

In Adansi West, however, the two teachers trained for primary schools could be from any of three upper classes. As at now at least two teachers from each of the schools in the Adansi West District have received STM training.

3.03 Further Development after Mid-Term Review

From the above observations, the Project has introduced some measures after the mid-term review to attempt to address some of the challenges as outlined. Most of such innovations were introduced first in Akuapem North District.

1. The introduction of Induction training to ensure that all teachers who happened to join the upper primary and JSS science and mathematics teachers were also given a six-day training.
2. The introduction of school-based INSET to ensure that when teachers are trained they will have the opportunity to immediately and continuously share their experiences with other colleagues and to ensure that the absence created often by the attrition of STM trained teachers will be minimized. In view of this the curriculum leader training was also instituted in Akuapem North district to provide additional training for some selected STM trained teachers so that they could support the school-based INSET. Almost half (60) of the primary schools have benefited from the curriculum leader training and have received support from the Project to enable them organise school-based INSET after mid-term review.
3. Handouts as regards the teaching of certain topics are also provided to STM trained teachers so that they could make reference or share with other colleagues.
4. Headteachers' seminar to expose headteachers to the practices of the Project and to encourage them to support the STM trained teachers and other teachers to promote science and mathematics education in the schools. All headteachers except those new in the three districts have at least had once of such seminars in 2003/4.
5. Seminar for Circuit Supervisors: to expose them to the practices of STM Project to enable them also to support the STM trained teachers and others to promote science and mathematics education in the schools. One of such seminars has so far been organised in each of the three districts. The Project has supported the supervisors in the monitoring of STM trained teachers in the three districts.
6. Science and Mathematics Fairs and Quizzes: to encourage teachers and pupils to be more interested in the subjects and to help improve their performance in science and mathematics. Apart from Akuapem North district which has so far organised three successive fairs, the two other districts have organised once in 2004.
7. Tracking of STM trained teachers: to ensure that the movement of the STM trained teachers are determined. The exercise started after the mid-term review in all the three districts.

In addition to the above innovations, the Project has had several workshops since the mid-term evaluation to review the activities of the Project aimed at improving INSET delivery and other interventions to improve science and mathematics education in the schools. Among the participants were:

a. District Directors of the project areas
b. Principals of TTCs in the three project areas
c. Headteachers
d. STM trained teachers
e. TTC science and mathematics tutors
f. Counterparts and Experts

3.1 Summary

The STM project started with a baseline survey which was used to determine the level of achievement of upper primary and JSS pupils in science and mathematics in three project areas. It also identified weaknesses in teaching and learning of science and mathematics. Instructional practices and pupils' attitudes to science and mathematics were also explored. The information derived from the baseline survey formed the basis for planning appropriate intervention strategies through INSET. The STM INSET emphasised activity oriented and child centred approaches based on the following categories:

(a) Problem solving approach to teaching mathematics to help pupils think more thoroughly
(b) Survey of curriculum materials and explanation of terms used in lesson notes preparation
(c) Observation of model lessons and discussions centred on the critical elements that made such lessons so effective
(d) Preparation of effective lesson notes
(e) Presentation of lessons by participants through micro teaching
(f) Designing, making and using teaching and learning materials
(g) Teaching of difficult and challenging topics from the upper primary and JSS syllabuses.

In order to reinforce the practices learnt at the INSET, a monitoring exercise was instituted. This exercise involved expatriate experts from Japan and local counterpart experts in science and mathematics moving to schools in the project districts to observe teachers' lesson preparation and delivery and to help them improve on their instructional delivery. This periodic monitoring was intended to identify shortcomings and to feed this back into ongoing INSET for teachers.

4.0 Presentation of Final Evaluation Results and Discussion

This section of the report focuses on responses to questionnaires by STM trained teachers, headteachers, circuit supervisors, TTC STM trained teachers, focus group interviews with all the groups mentioned, and results of pupils' achievement test. General discussions of issues emanating from the final evaluation survey and other analysis involving STM INSET are discussed. Also the findings from the science and mathematics achievement tests, the results of the final evaluation survey are compared with that of the mid-term baseline survey and the necessary conclusions drawn.

4.1 Impact of STM INSET on teachers' performance

The impact of STM INSET on teachers' performance was assessed using questionnaires, focus group interviews and classroom observations. The focus group interviews concentrated on the views of STM trained teachers and circuit supervisors the impact of INSET provided by the STM project.

4.1.1 Classroom Assessment of Impact of INSET

The results of the assessment of the lesson notes of upper primary school teachers before and after the STM INSET in science and mathematics are shown in Table 6. The lesson notes were assessed in seven areas namely objectives, introduction, TLMs development, core points, evaluation/exercises and overview. It can be seen from Table 6 that in all the areas assessed in science before STM INSET, scores ranged from 1.9 to 2.2 below the mean score of 3.0. TLMs had the lowest score of 1.9. After the STM INSET, Table 6, again, shows that in all the areas assessed, teachers' mean scores ranged from 2.8 to 3.2, three of which were above 3.0. The three areas were objectives, TLM and development. There were also improvements in all the seven areas assessed. This is illustrated in Figure 1. The greatest improvement recorded was in TLMs followed by evaluation. For mathematics it can be seen from Table 6 in all the areas assessed, teachers' mean scores were below the mean of 3.0 ranging from 1.7 to 2.3. TLMs had the lowest score of 1.7. After the STM INSET, Table 6 shows that teachers' mean scores in each of the areas assessed the mean scores ranged from 2.9 to 3.1. In four of the areas, the scores were above the mean score of 3.0. These were objectives, development, core points and overview. There were also improvements in all the seven areas assessed and this is illustrated in Figure 2. The greatest improvement recorded was in TLMs in both science and mathematics. Thus the inclusion of TLMs in lesson notes was the biggest change for upper primary school teachers after the STM INSET.

Table 6: Pre and post assessment of lesson notes in Science and Mathematics of upper primary school teachers

Areas	Science		Mathematics	
	PRE	POST	PRE	POST
Objective	2.5	3.2	2.2	3.1
Introduction	1.9	2.8	2.2	3.0
TLMs	1.9	3.1	1.7	2.9
Development	2.2	3.1	2.3	3.1
Core Points	2.1	2.9	2.2	3.1
Evaluation	1.9	2.9	2.2	2.9
Overview	2.2	2.9	2.6	3.1

Maximum score = 5.0; mean score = 3.0

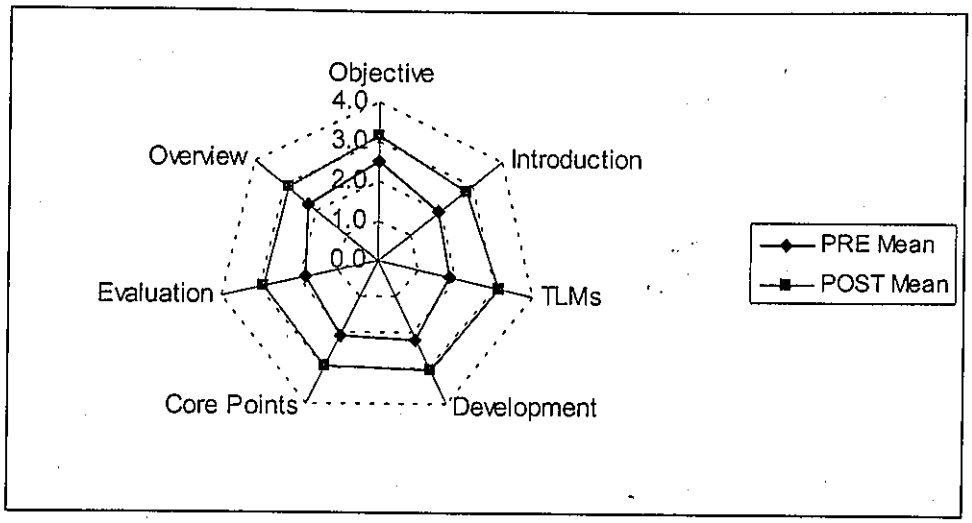


Figure 1: Pre and post lesson notes assessment gain scores of upper primary teachers in Science

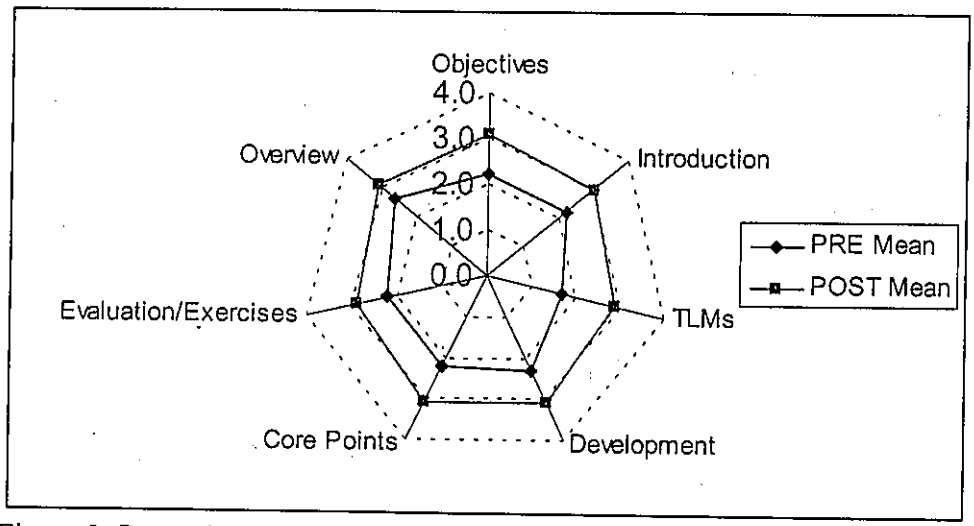


Figure 2: Pre and post lesson notes assessment gain scores of upper primary teachers in Mathematics

Lesson presentations in science and mathematics by teachers in the upper primary school were assessed in the following five areas: method of teaching, teacher's knowledge of subject matter, personal and professional attributes, learner's activities, and subject specific matters. The results are shown in Table 7 and illustrated in Figures 3 and 4 for science and mathematics respectively. It can be seen from Table 7 and Figures 3 and 4 that there were improvements in all the areas assessed in both science and mathematics respectively. In both mathematics and science, method of teaching and subject specific matters were two areas teachers had the greatest improvements. Subject specific matters consisted of evaluation work, proper use of materials, discussions and clear instruction. The area of assessment which recorded the least improvement was personal and professional attributes which had to do with verbal facility, teachers' confidence and relationship to the learners among others.

Table 7: Pre and post assessment of lesson presentation in science and mathematics of upper primary school teachers

Areas	Science		Mathematics	
	PRE	POST	PRE	POST
Method of teaching	2.3	3.0	2.3	3.1
Teacher's knowledge of subject matter	2.6	3.0	2.7	3.3
Personal and professional attributes	3.0	3.3	3.0	3.4
Learners' activities	2.3	2.9	2.6	3.2
Subject specific matters	2.0	2.9	2.0	2.8

Maximum score = 5.0; mean score = 3.0

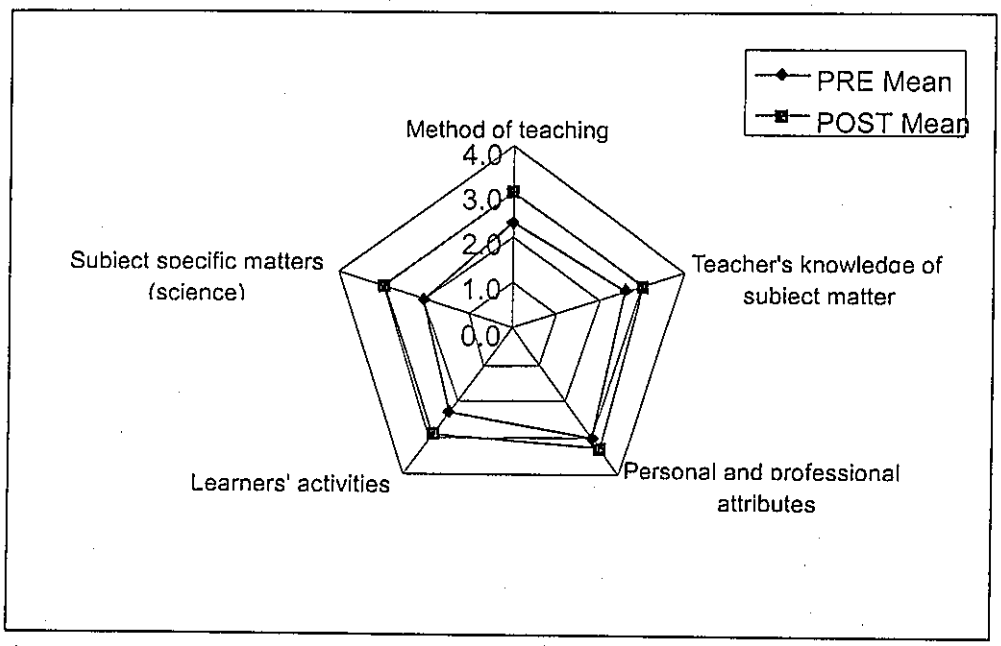


Figure 3: Pre and post lesson presentation assessment gain scores of upper primary teachers in science

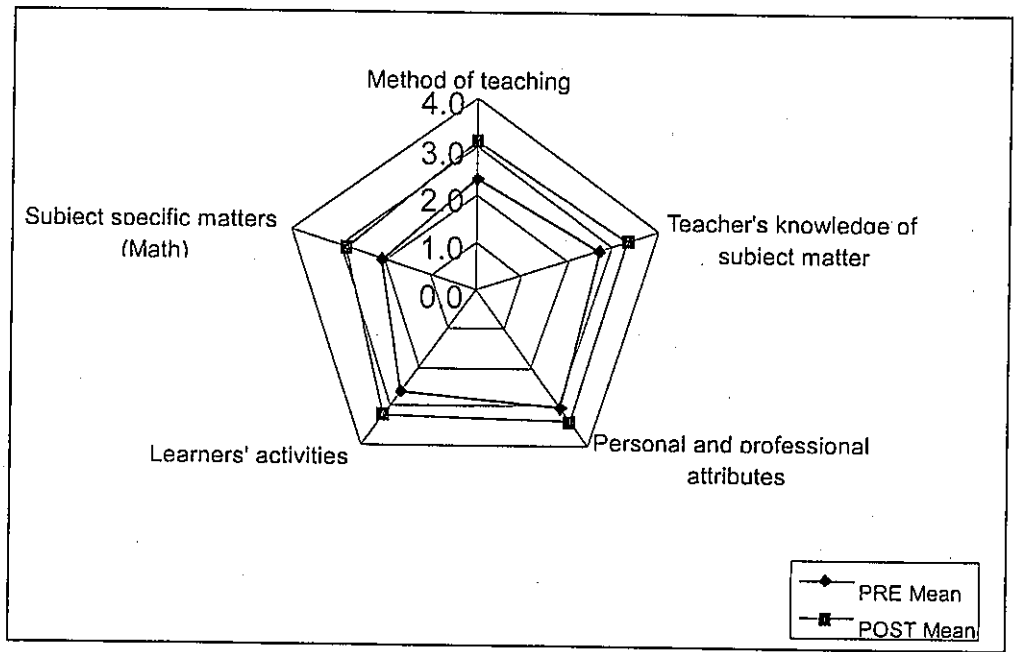


Figure 4: Pre and post lesson presentation assessment gain scores of upper primary teachers in mathematics

The results of the assessment of the lesson notes of JSS teachers before and after the STM INSET in science and mathematics are shown in Table 8. The lesson notes were assessed in seven areas namely objectives, introduction, TLMs development, core points, evaluation/exercises and overview as it was in the case of upper primary school teachers. Before the INSET, teachers' mean scores in science ranged from 1.9 to 2.5 and 1.5 to 2.6 in mathematics. After the STM INSET, Table 8 shows that in all the areas assessed, teachers' mean scores ranged from 2.8 to 3.2 in science and 3.3 to 3.8 in mathematics. There was therefore better performance in science and mathematics by teachers after the INSET. The improvements are illustrated in Figures 5 and 6 for science and mathematics respectively. The greatest improvement recorded was in TLMs in both science and mathematics. Thus the inclusion of TLMs in lesson notes was the biggest change for JSS teachers after the STM INSET. Apart from TLMs, introduction and evaluation also improved considerably in mathematics and evaluation in science.

Table 8: Pre and post assessment of lesson notes in science and mathematics of JSS teachers

Areas	Science		Mathematics	
	PRE	POST	PRE	POST
Objective	2.5	3.2	2.5	3.5
Introduction	1.9	2.8	2.3	3.4
TLMs	1.9	3.1	1.5	3.3
Development	2.2	3.1	2.2	3.5
Core Points	2.1	2.9	2.2	3.3
Evaluation	1.9	2.9	2.1	3.4
Overview	2.2	2.9	2.6	3.5

Maximum score = 5.0; mean score = 3.0

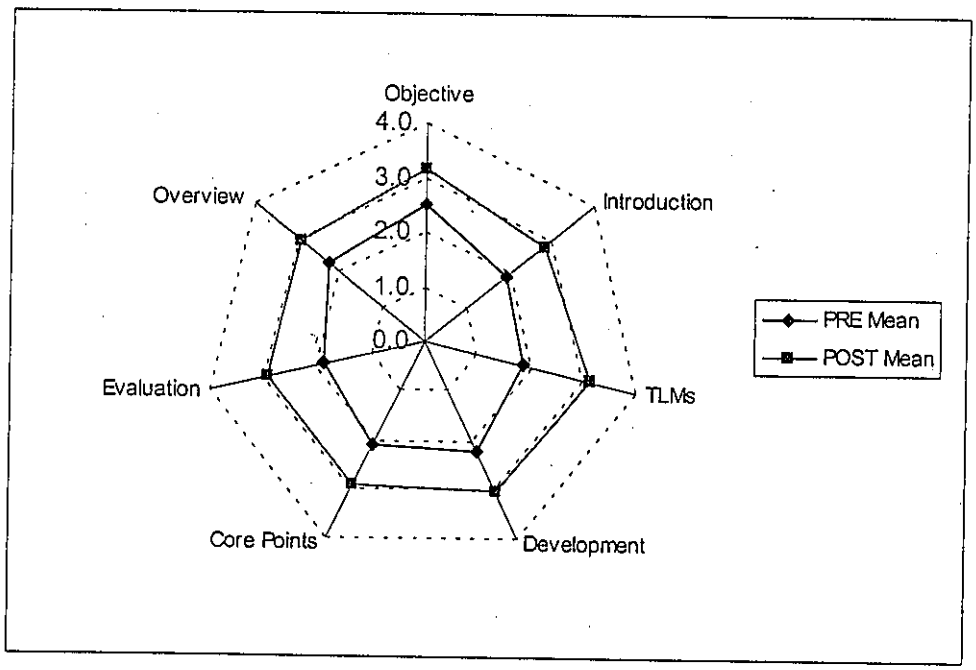


Figure 5: Pre and post lesson notes assessment gain scores of JSS teachers in science

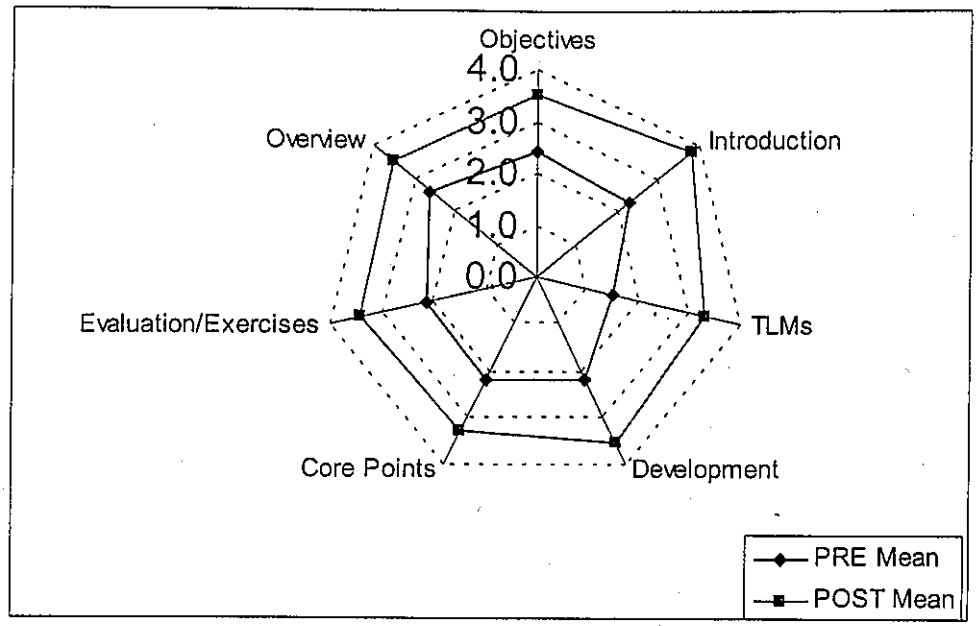


Figure 6: Pre and post lesson notes assessment gain scores of JSS teachers in mathematics

The lesson presentations in science and mathematics by teachers at the JSS level were assessed in the five areas. These were method of teaching, teacher's knowledge of subject matter, personal and professional attributes, learner's activities, and subject specific matters. The results are shown in Table 9 and illustrated in Figures 7 and 8 for science and mathematics respectively. It can be seen from Table 9 and Figures 7 and 8 that there were improvements in all the areas assessed in both science and mathematics. The post assessment mean scores for each of the five areas in mathematics were all above the mean score of 3.0 compared to the pre assessment mean scores where scores in three areas fell below 3.0. In mathematics, method of teaching and subject specific matter were two areas teachers had the greatest improvements compared to the other areas as shown in Figure 8. The same can be said for science in Figure 7.

Table 9: Pre and post assessment of lesson presentation in Science and Mathematics of JSS teachers

Areas	Science		Mathematics	
	PRE	POST	PRE	POST
Method of teaching	2.3	2.8	2.2	3.4
Teacher's knowledge of subject matter	2.7	3.1	2.0	3.5
Personal and professional attributes	3.0	3.2	3.0	3.7
Learners' activities	2.5	3.1	2.6	3.5
Subject specific matters	2.0	2.8	2.1	3.1

Maximum score = 5.0; mean score = 3.0

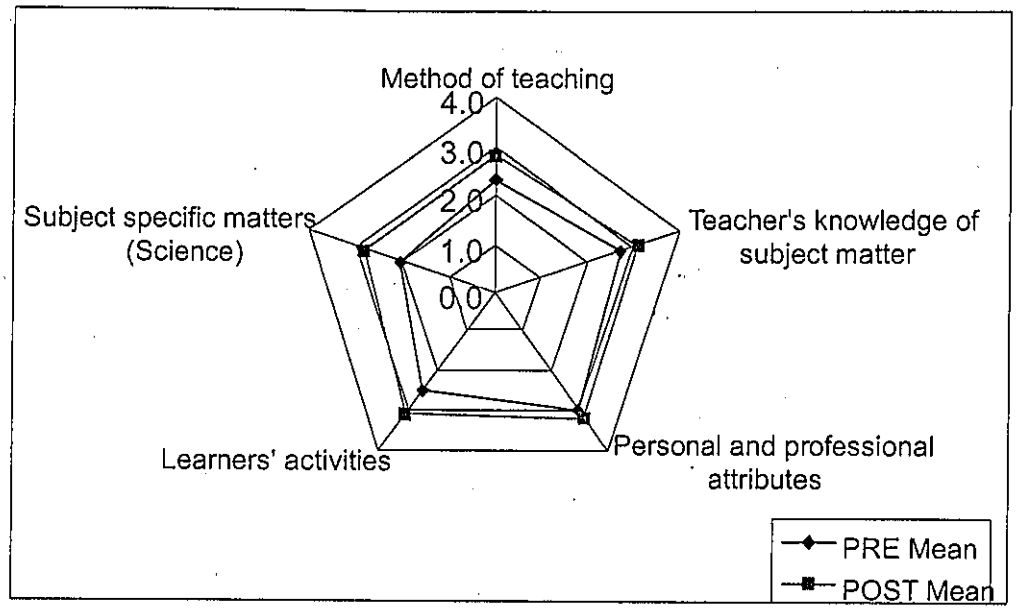


Figure 7: Pre and post lesson presentation assessment gain scores of JSS teachers in science

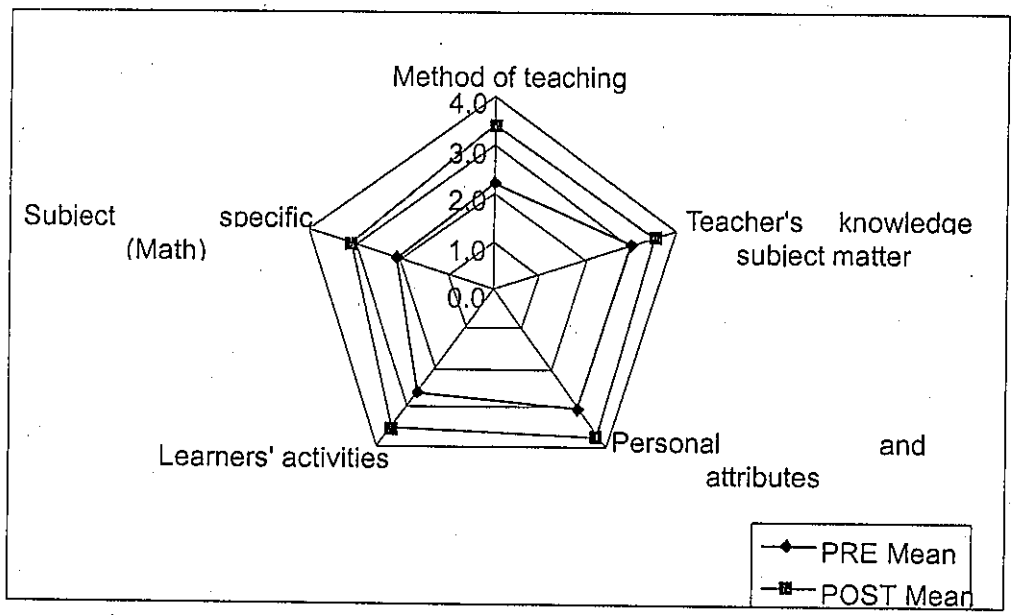


Figure 8: Pre and post lesson presentation assessment gain scores of JSS teachers in mathematics

4.1.2 Influence of STM INSET on practices in basic schools

During focus group interview, STM trained teachers indicated that topics selected for STM INSET were relevant to them since some of the topics were topics they found difficult to teach. Teachers were unanimous in their agreement of the fact that the topics covered at INSET were relevant and the lessons covered at the INSET were applicable to their classroom situation. However, the teachers felt that TLMs given to them to take to their schools were grossly inadequate. They also stated that the number of days for the INSET should be increased.

All the 22 circuit supervisors who responded to the questionnaire indicated that their presence at the STM INSET which was organised for classroom teachers had helped them very much. They therefore saw the training as very necessary. It is worthy of note that none of the 22 circuit supervisors had specialized in science and mathematics. Therefore equipping them with skills with which they could support the teachers in science and mathematics in the three districts was a relevant and important step even though the INSET was not specifically organised for them. As the circuit supervisors themselves indicated their *"knowledge in science and mathematics has been sharpened as a result of these workshops"*. As a result they claimed they had been *"able to give support to teachers in the preparation of mathematics and science TLMs"* and also *"monitor teachers' lesson delivery in mathematics and science more effectively and with keen interest"* than they had done before.

TTC tutors indicated during focused group interviews that their presence at the STM INSET had influenced their teaching of science and mathematics in their colleges. They said that they use a lot of activities and TLMs in their teaching compared to the situation prior to the attending the STM INSET that was organised for basic school teachers. According to them they had learnt new concepts, skills and methodology of teaching. In fact, all their responses portrayed positive influences of STM INSET.

Circuit supervisors made a number of observations in their responses to questionnaires given to them. These concern the attitude of upper primary and JSS teachers prior to the institution of STM INSET. The following gives a summary of the key ones:

- Teachers used to avoid challenging topics in the science and mathematics syllabuses, partly due to lack of adequate knowledge of the topics or appropriate skills in teaching them. Teachers did not usually teach science and mathematics using TLMs and most of them were not even adequately equipped to do so. Also teachers did not involve their pupils in practical activities.
- Headteachers did not pay particular attention to the teaching and learning of science and mathematics, and did not usually provide assistance in the production of TLMs by teachers
- Schools and districts were not making provision for INSET in mathematics and science to help teachers prepare adequately for lesson delivery in these subjects.

Circuit supervisors however observed during focus group interview that after the STM INSET, the school monitoring they have done has shown that the STM INSET had made some positive impact on STM trained teachers. A summary of the comments made by circuit supervisors show that enormous changes have occurred STM trained teachers' classroom practice. According to circuit supervisors from the three project districts, generally

- there is now effective and relevant introduction linked with relevant previous knowledge than was not the case before the STM INSET. Very effective and varying methods are used by teachers with learner-centred activities in their lesson notes for developing their lessons. Teachers also conclude in their lesson notes varying feedback techniques to emphasise main teaching/learning points
- there has been a marked improvement in the presentation of lesson as teachers provide adequate information in the core points column. Appropriate objectives are stated.

- many STM trained teachers now use the activity and discussion methods instead of the lecture method, which is perceived as abstract. Lessons in science and mathematics have become more child-centred with the use of TLMs than was the case before the STM INSET
- STM trained teachers now show interest in the preparation and use of TLMs even though in practice TLMs are not always prepared by teachers due mainly to lack of funds.

All headteachers interviewed were unanimous in asserting that the STM INSET had made considerable impact on the teaching of science and mathematics in their schools. The observations made by circuit supervisors were therefore collaborated by the circuit supervisors. Some specific positive changes mentioned by headteachers were as follows:

- Approach to teaching has changed. Teachers now teach using TLMs and there are more practical activities during teaching. Pupils interact with the TLMs by handling them and it makes them more interested in the class.
- Lessons are more systematic in presentation and more assignments are now given.
- Teachers trained by STM are preparing better lesson notes than other teachers. Good objectives, core points and activities using TLMs have become part of STM trained teachers practice.
- Pupils' participation in mathematics and science has improved. Pupils have cultivated the habit of exploring by themselves.
- Mathematics and science clubs have been formed in some of the schools.
- TLMs brought from the INSET are available for use by other teachers.

The impact of these positive changes can be seen in Table 10. Table 10 shows that majority of primary (65.9%) and JSS (66.3%) pupils claimed they understood lessons better now than in the past. Maturity could be a factor that explains pupils' ability to understand lessons better now than in the past. Teachers' improved skills in lesson delivery through STM INSET could also be a contributory factor. This is seen from Table 11 which shows that majority of pupils said they could concentrate on what was being taught in science (89.2% of primary pupils and 92.5% of JSS pupils) and mathematics (87.3% of primary pupils and 91.3% of JSS pupils) than in the past. The fact that the majority of pupils seem to concentrate on lessons in mathematics and science shows they had developed interest in the two subjects and the interest in the two subjects appears to be translating into the better understanding pupils maintained they now have. No doubt science and mathematics (as shown in Tables 12 and 13) constituted two subjects stated by the pupils as the subjects they liked best. Table 9a shows that 19.6% of primary school pupils indicated science as their first choice with 29.8% of JSS pupils indicating the same. A higher proportion of pupils in both primary (49.5%) and JSS pupils (37.7%) indicated mathematics as their first choice of best subjects compared to science. Circuit supervisors also indicated that both male and female pupils were showing more interest in science and mathematics and as a result there had been an improvement in pupils' performance in the two subjects in the three districts.

Table 10: Do you understand lessons better now than in the past?

	Primary		JSS	
	No.	%	No.	%
Do not know	6	1.6	0	0
No	123	32.5	167	66.3
Yes	249	65.9	85	33.7
Total	378	100.0	252	100

Table 11: Can you concentrate during science/mathematics lessons?

	Primary				JSS			
	Science		Mathematics		Science		Mathematics	
	No.	%	%	No.	No.	%	%	No.
Do not know	3	0.8	0	0	0	0	0	0
No.	38	10.1	48	12.7	19	7.5	22	8.7
Yes	337	89.2	330	87.3	233	92.5	230	91.3
Total	378	100.0	378	100.0	252	100.0	252	100.0

Table 12: Three subjects primary school pupils liked best

Subjects	1st Choice		2nd Choice		3rd Choice	
	No.	%	No.	%	No.	%
Science	74	19.6	132	34.9	86	22.8
Maths	187	49.5	67	17.7	43	11.4
English language	88	23.3	110	29.1	94	24.9
RME	16	4.2	30	7.9	74	19.6
Env. Studs	9	2.4	23	6.1	56	14.8
Gh. Lang.	4	1.1	15	4.0	21	5.6
French	-	-	1	0.3	2	0.5
Agric.	-	-	-	-	1	0.3
Voc.Skills	-	-	-	-	1	0.3
Pre-Tech	-	-	-	-	-	-
Music	-	-	-	-	-	-
PE	-	-	-	-	-	-
Life Skills	-	-	-	-	-	-

Table 13: Three subjects JSS school pupils liked best

Subjects	1st Choice		2nd Choice		3rd Choice	
	No.	%	No.	%	No.	%
Science	75	29.8	68	27.0	55	21.8
Maths	95	37.7	56	22.2	24	9.5
English language	48	19.0	57	22.6	62	24.6
RME	6	2.4	10	4.0	24	9.5
Env. Studs	2	0.8	18	7.1	25	9.9
Gh. Lang.	7	2.8	13	5.2	8	3.2
French	2	0.8	3	1.2	4	1.6
Agric.	10	4.0	14	5.6	18	7.1
Voc.Skills	4	1.6	7	2.8	2	0.8
Pre-Tech	3	1.2	6	2.4	16	6.3
Music	-	-	-	-	14	5.6
PE	-	-	-	-	-	-
Life Skills	-	-	-	-	-	-

Tables 14, 15 and 16 give an idea of pupils educational and career ambitions. Table 14 clearly shows that an overwhelming majority of the pupils (95.5% of primary school pupils and 97.2% of JSS pupils) would want to continue with their education after completing JSS.

The educational ambition of pupils is further supported by Table 15 which shows that 95.8% of primary school pupils and 98.0% of JSS pupils would want to continue their education to different levels, with most of them (70.1% of primary school pupils and 64.7% of JSS pupils) indicating that they would pursue their education up to the university level. This is an indication that most pupils seem to attach importance to education. Quite a number of pupils (39.9% of primary school pupils and 37.7% of JSS pupils) would want to enter science related professions, like medicine, nursing and engineering on the completion of their education (Table 16).

Table 14: What pupils will like to do after completing JSS

	Primary		JSS	
	No.	%	No.	%
No response	1	0.3	0	0
Do not know	5	1.3	4	1.6
Continue schooling	361	95.5	245	97.2
Work	11	2.9	3	1.2
Total	378	100.0	252	100.0

Table 15: Level of education pupils will want to attain

	Primary		JSS	
	No.	%	No.	%
No response	16	4.2	5	2
SSS	53	14.0	34	13.5
Polytechnic	10	2.6	9	3.6
University	265	70.1	163	64.7
Nursing Training	15	4.0	6	2.4
Training College	19	5.0	31	12.3
Learn a trade	-	-	3	1.2
Fire Service Training School	-	-	1	0.4
Total	378	100.0	252	100.0

Table 16: Some preferred occupations of pupils

	Primary		JSS	
Occupation	No.	%	No.	%
Medicine	95	25.1	45	17.9
Teaching	55	14.6	53	21.0
Nursing	50	13.2	34	13.5
Seamstress/Tailor/Hairdresser	35	9.3	4	1.6
Journalist	15	4.0	16	6.3
Banker	17	4.5	12	4.8
Engineer	6	1.6	16	6.3
Pilot/Air Hostess	14	3.7	7	2.8

Table 17 show that only 5.8% of primary school pupils and 5.6% of JSS school pupils indicated that they never use science in their daily lives. Also from Table 18 a small proportion of 3.2% of primary school pupils and 2.0% of JSS pupils indicated that they never use mathematics learnt in school in their day to day lives. This seems to suggest that most pupils in the project schools are aware of the application of the science and mathematics learnt in school in their daily lives.

Table 17: Do you use science in your daily life?

	Primary		JSS	
	No.	%	No.	%
Never	22	5.8	14	5.6
Sometimes	147	38.9	117	46.4
Often	101	26.7	53	21.0
Always	108	28.6	68	27.0
Total	378	100.0	252	100.0

Table 18: Do you use mathematics experiences in your daily life?

	Primary		JSS	
	No.	%	No.	%
Never	12	3.2	5	2.0
Sometimes	139	36.8	122	48.4
Often	97	25.7	49	19.4
Always	130	34.4	76	30.2
Total	378	100.0	252	100.0

Reponses from the headteachers' questionnaire shows that about a third of them (31.4%) have been headteachers for less than 5 years. The background of the headteachers also indicate that 56.0% were 4-year Post Middle Certificate A holders and that out of the 523 headteachers who responded to the questionnaire, only 6.3% had specialised in mathematics or science. With this background of headteachers, it is not surprising that almost all headteachers (99.8%) were willing to accept new ideas from STM trained teachers (Table 19). This seems to suggest that almost all headteachers appreciated the changes introduced by STM, in terms of lesson notes preparation and delivery.

Table 19: Willing to accept new ideas from STM trained teachers

	No.	%
Hard to tell	1	0.2
Agree	176	33.7
Strongly agree	346	66.2
Total	523	100.0

From Table 20 it can be seen that most headteachers (99.4%) were willing to organize school-based INSET to enable STM trained teachers share ideas with their colleagues. This again appears to be a testimony of the fact that most headteachers had recognized the contributions of STM INSET and would therefore allow STM trained teachers to share ideas with their colleagues through school-based INSET.

Table 20: Willing to organise school-based INSET to enable teachers share STM experience

	No.	%
Hard to tell	3	0.6
Agree	231	44.2
Strongly agree	289	55.3
Total	523	100.0

4.1.3 Lesson notes preparation

STM trained teachers interviewed made a number of observations about the impact of the STM INSET. The first was on the preparation of lesson notes. The common ones are quoted below:

(a) Now we write lesson notes taking into account group work. Formally we did not include introduction, conclusion and application of activities but now we include all these.

(b) We use syllabuses, textbooks and other reference books in preparing lesson notes. After the INSET, we now know the TLMs to use in preparing lesson notes.

(c) Activities in our lesson notes now correlate with the objectives and core points.

(d) We use to prepare weekly notes but now we prepare lesson notes on daily basis. Lesson notes are no longer difficult to prepare.

The observations made by STM trained teachers were collaborated by circuit supervisors and headteachers during focus group interviews. Circuit supervisors and headteachers indicated that after the STM INSET, teachers started preparing detailed, comprehensive and activity oriented lesson notes which used not to be the case.

4.1.4 Lesson presentation by STM trained teachers

According to the STM trained teachers, their lessons were more pupil-centred than used to be the case before the STM INSET. They now give their pupils the chance to contribute to lessons. According to the STM trained teachers, they used to talk a lot during lesson delivery but this has changed as they now give pupils the chance to also talk during lessons. The way lessons are introduced and developed has also changed due to the change in lesson notes preparation. Teachers indicated that they now do a lot of group work which allow children to take active part in lessons.

Some STM trained teachers at the upper primary school level complained that the challenge of language made child-centred lessons difficult since the children found it difficult to express themselves in English language. It therefore took a longer time to complete a topic using child-centred approach than the traditional way of teaching.

According to the teachers, generally, the attitude of pupils towards science and mathematics has changed. Pupils have become more interested in science and mathematics. Some teachers cited instances where pupils, particularly girls at the JSS level had come to like working exercises in mathematics and science.

Headteachers corroborated the views expressed by the circuit supervisors. Table 21 presents the views of the headteachers on the issue of whether STM INSET had led to improvement in the capacity of teachers to teach science and mathematics and also to the provision of provide materials for the preparation of TLMs. Table 20 shows that almost all headteachers (99.0%) thought that the STM INSET was useful in improving the capacity of teachers to teach. Most headteachers observed that there were differences between the STM trained teachers and the other teachers who had not benefited from STM training. Most of them asserted that the STM trained teachers were performing better than the other teachers. The reason for this assertion was that the STM trained teachers prepared better lesson notes and their lesson delivery were activity oriented. According to them this had aided pupils' understanding and interest in mathematics and science in their schools.

Table 21: I think STM INSET is useful in improving teachers' capacity for teaching science and mathematics

	No.	%
Disagree	1	0.2
Hard to tell	4	0.8
Agree	132	25.2
Strongly agree	386	73.8
Total	523	100.0

4.1.5 Preparation and use of TLMs

According to the STM trained teachers a number of improvements in the use of TLMs had resulted from the exposure they received at the STM INSET. The key ones are stated below:

a) Teachers' use of TLMs to teach science and maths has improved. However, they cannot prepare more TLMs because of lack of funds.
b) Teachers now prepare TLMs and use them. Formally, most lessons were taught without the use of TLMs because teachers did not know what TLMs to use but now this has changed.

These observations by STM trained teachers confirm the results of lessons notes and lesson presentations by teachers that were assessed by the STM project.

However, the STM trained teachers conceded that the organisation of practical activities in science had been hampered by the problem of getting TLMs. Lack of funds and the fact that not everything can be improvised account for this situation. At the JSS level, teachers observed that activities take too much time to complete and this has had an effect on the completion of the syllabus for JSS science. During headteachers' interview, headteachers indicated that materials supplied to the schools by the STM project were inadequate confirming what the STM trained teachers had said. So even though the materials were very useful, they were so few to go round teachers in the schools. Schools therefore had to supplement the materials with their own scarce resources. According to the headteachers, even though teachers were told to improvise, they could not improvise some of the materials used at the INSET due to lack of funds and therefore and had to do without the appropriate TLMs on some occasions. Also the headteachers admitted that sometimes the materials teachers needed to help them improvise could not be given to them due to lack of funds.

However, headteachers were willing to provide materials for TLM preparation by teachers Responses from the headteachers' questionnaire presented in Table 22 indicate that 98.3% of them were willing to provide teachers with materials to prepare TLMs.

Table 22: Willing to provide materials for TLM preparation

	No.	%
Disagree	1	0.2
Hard to tell	8	1.5
Agree	221	42.3
Strongly agree	293	56.0
Total	523	100.0

STM trained teachers also enumerated a number of constraints in the preparation and use of TLMs. The most significant one being money. According to them, sometimes money was not made available by their headteachers to buy cards and other materials for TLMs. As a result

of this, they were not able to prepare or use TLMs as many times as they wished. They also observed that some of the materials found at the workshops during the STM INSET were not available in their schools. In a few schools teachers admitted there had been very little change in the use of TLMs in the lessons STM trained teachers had taught due to lack of funds. Time to prepare TLMs was also cited as a problem because teachers claimed that they had to teach so many subjects and this made it difficult for some of them to concentrate on mathematics and science. Teachers in schools in rural areas also complained that most of the time, pupils failed to bring some of the materials needed for lessons. Teachers therefore had to provide every material needed for their lessons and this put a lot of strain on their own finances. Some teachers also indicated that they had difficulty making good drawings for their pupils. They therefore had to employ artists at their own expense to make some of the drawings.

The headteachers enumerated a number of constraints and problems. The most cited being inadequate funds. Headteachers thought that their mathematics and science teachers were teaching better than formerly but they were hampered by the lack of equipment and materials especially for science.

4.2 Support received by teachers

According to the STM trained teachers their headteachers provided TLMs or money to purchase them when they needed them. However, this was possible only when headteachers received money from the districts. They observed that because of this, support from headteachers had not been very regular. A few of the teachers however, indicated that no financial support had given to them by their headteachers in the purchase of materials for TLMs and that money used to purchase TLMs came from their own resources. Others claimed that support was given to teachers only when circuit supervisors were coming to inspect teachers' lesson notes and exercises done by pupils.

Those in the Adansi West District were all unanimous that they had not received any support from TTC tutors. They also conceded that circuit supervisor periodically visited them and helped them with certain topics but this was not regular. However, some claimed that circuit supervisors came to their schools only to find fault with their lesson notes and lesson presentation instead of giving them help.

Another area of support for teachers could have come from those who had received STM INSET. However, interview with headteachers revealed that in most cases there had been very little formal interaction among schools and among teachers. In the JSS for example, there were no other teachers STM trained teachers could share their experiences with. Also even when school based INSET was organised the provision of TLMs for them to share effectively their experiences with other teachers could not be provided by the schools.

4.3 Sustaining the change in teachers professional practice

STM trained teachers, headteachers, circuit supervisors and TTC tutors made a number of suggestions which in their opinion could help sustain the change the STM INSET had brought to teachers' professional practice. These are:

- Continuous INSET at school and circuit levels and provision of TLMs to the schools.
- Regular supervision and monitoring of teaching from the district offices
- Teaching of English language should be intensified as no child can understand and work problems in science and to some extent mathematics without being able to read and understanding the questions.

- Formation of groups of mathematics and science teachers in the circuit to meet periodically to discuss the teaching and learning of science and mathematics at the circuit or school level.
- Materials which schools cannot provide should be made available to the schools to support the teachers by the circuits or districts.
- There must also be adequate provision of curriculum materials for teachers to use.
- Districts must find a way of evaluating teachers' practices to see whether the promising practices learnt at INSET are being implemented in the schools.
- Circuit supervisors must give direct support to teachers on the field.
- Subject coordinators for science and mathematics must be instituted and they should meet with science and mathematics teachers from time to time.
- Circuit supervisors should be made more mobile by providing them with money for fuel to be able to go to the field to monitor teachers.

4.4 Performance of Pupils by District, Class and Gender in Upper Primary and JSS in Science

4.4.1 Upper Primary School

The upper primary science test consisted of 34 multiple-choice items with four response options A to D. Apart from two questions which carried two marks each, the other questions carried three marks each making a total of 100 marks for the test. The standard of 10 out of the 34 questions, were at the level of P4 pupils, 19 out of the 34 questions were at the level of P5 pupils, and 31 out of the 34 questions were at the level of P6 pupils. There were three general questions which were not tied to any level. The same test was given to the upper primary school pupils in the mid-term baseline survey. The overall performance of the pupils in the upper primary science test in both surveys is presented in Table 23.

Table 23: Overall performance of upper primary school pupils by district

District	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Akuapem North	954	34.6	14.1	838	36.7	14.6
Tamale	733	37.2	13.2	820	39.6	13.9
Adansi West	573	32.2	11.8	604	33.0	11.7
Total	2260	34.8	13.4	2262	36.7	13.8

Maximum score = 100%

The results of the upper primary science test in the three project districts in the final evaluation survey as shown in Table 23 indicate a mean score of 36.7% compared to 34.8% by primary school pupils in the mid-term baseline survey. This result therefore shows an overall significant improved performance in science by upper primary school pupils over their counterparts in the mid-term baseline test $t(4520) = 4.69$, $p<0.05$. Also in each district, the upper primary school pupils used in the final evaluation survey performed better than their counterparts in the mid-term baseline survey. It can be seen from Table 23 that pupils in the Tamale District performed better than their counterparts in the other two districts in both mid-term baseline and final evaluation surveys. The standard deviation in Akuapem North District was the highest suggesting a wider ability range of upper primary school pupils in the

district compared to the others. A similar result was obtained in the mid-term baseline survey. Analysis of variance (ANOVA) shows that the mean scores on the upper primary science test were significantly different among the three districts F (2, 2259) = 40.55, p <0.05. Multiple comparison tests further indicated that the mean differences were significant at the 0.05 level for any two districts.

The results of the performance test in science by class as reported in Table 7 shows that pupils in P6 performed better than pupils in P5 and P4 in that order. This is to be expected since P6 pupils have had more exposure to the teaching and learning of science than P5 and P4 pupils. A similar trend was observed in the mid-term baseline survey. The variances among the three classes were significantly different ranging from 116.64 in P4 to 210.25 in P6. This means pupils from the three classes were at different levels in their knowledge of science. However, as Table 24 shows, pupils' performance in all the classes was slightly better than their counterparts in the mid-term baseline test.

Table 24: Overall performance in science of upper primary school pupils by class

Class	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
P4	776	29.2	9.6	800	30.9	10.8
P5	745	33.5	11.9	751	35.2	12.3
P6	739	42.2	14.7	711	45.0	14.5
Total	2260	34.8	13.4	2262	36.7	13.8

Analysis of variance (ANOVA) shows that the means on the upper primary science test were significantly different among the three classes, F (2, 2259) = 248.20, p <0.05. Follow-up statistical tests were conducted to evaluate pair-wise differences among the means of the three classes. The results of this post hoc comparisons indicated that there were significant differences in the mean scores between any two classes in favour of the class at the higher level. These results follow the same pattern observed in the mid-term baseline survey.

The results of the achievement test in science by gender reported in Table 25 shows that male pupils performed better than their female counterparts in both the mid-term baseline and final evaluation surveys.

Table 25: Overall performance in science of upper primary school pupils by gender

Gender	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Female	1150	33.9	12.6	1133	35.5	13.1
Male	1110	35.8	14.0	1129	37.9	14.5
Total	2260	34.8	13.4	2262	36.7	13.8

Also the performance of males and females in the final evaluation test were higher than their counterparts in the mid-term baseline test. The variances show a significantly wider range of abilities in males than females. Analysis using t-test showed a significant difference in achievement by gender in favour of the male pupils.

4.4.2 Junior Secondary School

The JSS science achievement test consisted of 44 multiple-choice items with four response options from A to D. Out of the 44 questions, 32 carried two marks each whilst the rest carried three marks each, giving a total of 100 marks for the test. The standard of 20 out of the 44 questions, were at the level of the JSS1 pupils whilst 34 out of the 44 questions were at the level of the JSS2 pupils. The 10 additional questions were at the level of JSS3 pupils. This same test was given to the JSS pupils who took part in the mid-term baseline survey.

The overall performance of pupils in the JSS science test is presented in Table 26.
The results of the JSS science achievement test in the three project districts as shown in Table 26 indicate a mean score of 39.5% which is significantly higher than the 38.2% obtained by the JSS pupils, $t\ (3075) = 2.78$, $p<0.05$, in the mid-term baseline survey. Of the three districts, JSS pupils in Adansi West had the lowest mean score of 36.8% with Akuapem North and Tamale Districts scoring a mean of 42.3% and 39.0% respectively. The same trend was observed in the mid-term baseline survey.

Table 26: Overall performance of JSS pupils in science by district

District	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Akuapem North	584	39.6	11.9	595	42.3	12.5
Tamale	425	39.5	16.3	430	39.0	15.1
Adansi West	516	35.6	11.0	527	36.8	10.9
Total	1525	38.2	13.1	1552	39.5	13.0

Maximum score = 100%

Also in each district, pupils used in the final evaluation survey performed better than those used in the mid-term baseline survey with the exception of pupils in the Tamale District. There is a clear cut trend in the performance of the districts in both surveys within each survey but not across surveys. The mean score in all three districts was above 33.0% which is the theoretical maximum score a pupil can obtain in the multiple choice test by merely guessing the correct answers. The standard deviation in Tamale was the highest (15.1 in final evaluation survey and 16.3 in mid-term baseline survey) suggesting a wider ability range of JSS1 and JSS2 pupils in the district compared to the other districts. This seems to suggest a wider range of performance of upper primary schools in the Tamale District compared to the other districts.

Analysis of variance (ANOVA) shows that the mean scores on the JSS science test were significantly different among the three districts, $F\ (2, 1549) = 26.18$, $p < 0.05$. Follow-up statistical tests were conducted to evaluate pair-wise differences among the mean scores. The results of this post hoc comparisons indicated that there were significant differences in the mean scores between any two districts.

The overall performance of pupils in the JSS science achievement test as represented in Table 27 shows a mean score of 39.5% in the three project districts in the final evaluation survey. This is higher than the score of 38.2% for JSS pupils in the mid-term baseline survey. The results of the final evaluation by class as reported in Table 26 shows that JSS2 pupils performed better than JSS1 pupils (42.9% for JSS2 compared to 36.4% for JSS1 pupils).

Table 27: Overall performance of JSS pupils in science achievement test by class

Class	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
JSS1	742	35.2	12.3	805	36.4	11.0
JSS2	783	41.0	13.2	747	42.9	13.3
Total	1525	38.2	13.1	1552	39.5	13.0

Maximum score = 100%

A similar trend was observed for the cohort of pupils in the mid-term baseline survey. This is to be expected since the JSS2 pupils were more matured and had had more exposure to the teaching and learning of science than pupils in JSS1. Also there were more questions at the level of JSS2 pupils that JSS1 pupils in the science achievement test. Analysis of the test questions show that 54.5% of the questions were above the level of the JSS1 pupils compared to 22.7% in the case of JSS2 pupils. The variances among the two classes ranged from 121.00 to 176.89 and were significantly different at the 0.05 level. This means that the ability range of JSS2 pupils was wider than JSS1 pupils in both surveys. An independent samples t-test was conducted to evaluate the hypothesis that JSS2 pupils' performance in the science achievement test was significantly better than that of JSS1 pupils. The test was significant, $t(1550) = -10.26$, $p<0.05$ indicating that mean scores of JSS2 pupils were significantly better from that of JSS1 pupils.

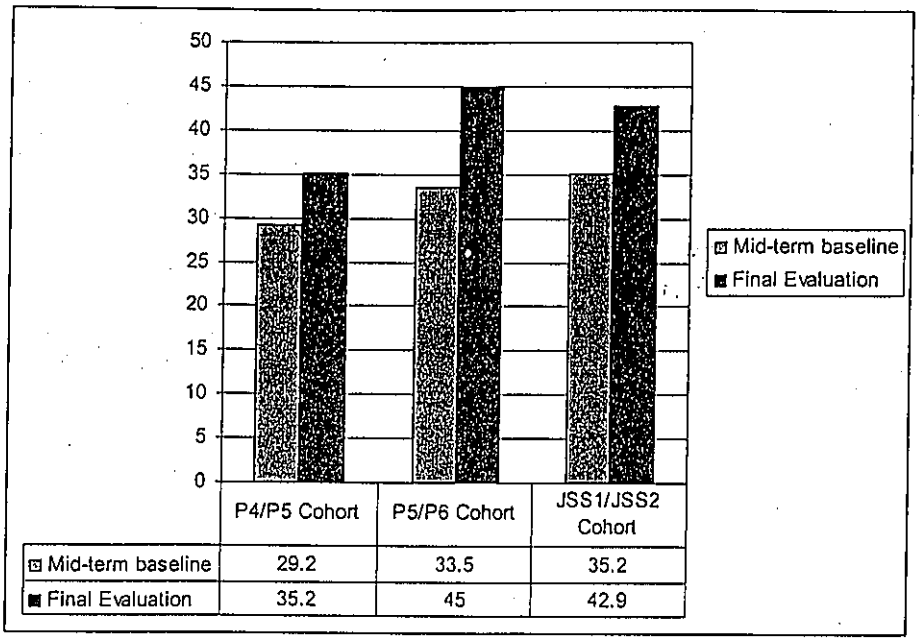
The results of the achievement test in science by gender reported in Table 28 shows that male pupils performed significantly better at the 0.05 level of significance than female pupils in both the mid-term baseline and final evaluation surveys. The performance of males and females in the final evaluation test were also higher than their counterparts of the mid-term baseline test. There were however, no significant differences in the range of abilities in male and female pupils in the mid-term baseline survey. However, in the final evaluation there was a significance difference in the abilities of male and female pupils as indicated by the range of standard deviation in Table 28.

Table 28: Overall performance of JSS pupils in science achievement test by gender

Gender	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Female	696	36.2	12.6	711	37.9	12.2
Male	829	39.9	13.3	841	40.9	13.5
Total	1525	38.2	13.1	1552	39.5	13.0

4.4.3 Comparison of same pupils in mid-term baseline and final evaluation surveys in science

At the time of the final evaluation survey, P4 pupils who took part in the mid-term baseline survey had moved to P5, those in P5 had moved to P6 and JSS1 pupils had moved to JSS2. Figure 9 shows the performance of the same cohort of pupils in the same tests a year apart. Figure 9 shows significant improvement in performance of each cohort of pupils. The figure shows that the P5/P6 cohort had the highest improvement in performance followed by the JSS1/JSS2 cohort and then the P4/P5 cohort.



	P4/P5 Cohort	P5/P6 Cohort	JSS1/JSS2 Cohort
Mid-term baseline	29.2	33.5	35.2
Final Evaluation	35.2	45	42.9

Figure 9: Performance of the same cohort of pupils in the mid-term baseline and final evaluation in the STM science achievement test.

Independent t-test analysis of mean scores between P4 pupils in the mid-term baseline and the mean scores of the same pupils in P5 at the final evaluation survey shows that there were significant, $t(1525) = -10.66$, $p<0.05$, improvements in their performance over the period. The same applies to the other cohorts ($t(1454) = -16.67$, $p<0.05$ for P5/P6 cohort; $t(1487) = -11.57$, $p<0.05$ for JSS1/JSS2 cohort).

4.5 Performance of Pupils by District, Class and Gender in Upper Primary and JSS in Mathematics

4.5.1 Upper primary School

The upper primary mathematics achievement test consisted of 43 multiple-choice items with mostly four response options from A to D, except for questions 30 and 31 which had five response options, A to E. There were 29 questions carrying 2 marks each and 14 questions carrying 3 marks each making a total of 100 marks for the test. The standard of only 13 out of the 43 questions, were at the level of the P4 pupils, 28 out of the 43 questions were at the level of P5 pupils and all the 43 questions were at the level of the P6 pupils. The P6 pupils therefore had a greater advantage to do well in the test. This same test was given to the upper primary school pupils during the mid-term baseline survey. The overall performance of pupils in the upper primary mathematics achievement test is presented in Table 29.

Table 29: Overall performance in mathematics achievement test of upper primary school pupils by district

District	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Akuapem North	954	35.5	15.1	838	37.7	16.4
Tamale	733	37.6	13.8	820	37.6	14.8
Adansi West	568	32.9	11.7	604	32.3	11.9
Total	2255	35.5	14.0	2262	36.2	14.9

Maximum score = 100%

The results of the upper primary mathematics achievement test in the three districts as shown in Table 29 indicate a mean score of 36.2% which is slightly higher than the mid-term baseline score of 35.5% but was not significantly different. In the final evaluation survey, pupils in the Akuapem North and Tamale Districts performed better than those in the Adansi West District with a mean score of 37.7% and 37.6% respectively compared to a mean score of 32.3% in the Adansi-West District. The trend was different in the mid-term baseline survey. In the mid-term baseline pupils in the Tamale District performed better than those in the other two districts with a mean of 37.6% followed by pupils in Akuapem North and Adansi West in that order. There is therefore no clear cut pattern in performance across the two surveys. In the Final Evaluation, the standard deviation in Akuapem North was the highest suggesting a wider ability range of primary schools in the district compared to the primary schools in the other two districts. This trend is not different from the trend in the mid-term baseline survey. Analysis of variance (ANOVA) shows that the mean scores on the upper primary mathematics achievement test were significantly different among the three districts $F(2, 2259) = 40.55$, $p < 0.05$. Multiple comparison tests further indicated that the mean differences were significant at the 0.05 level between Akuapem North and Adansi West Districts and between Tamale and Adansi West Districts but not between Akuapem North and Tamale Districts.

The results in the mathematics achievement test by class as reported in Table 30 shows that in the final evaluation survey, P6 pupils performed better than P5 pupils followed by P4 pupils. This trend is not different from the trend observed in the mid-term baseline survey. This trend is expected since the P6 pupils have had more exposure to the teaching and learning of mathematics and are more matured than P5 and P4 pupils in that order. Also there were more questions at the level of P6 compared to P5 and P4.

Table 30: Overall performance of upper primary school pupils in mathematics achievement test by class

Class	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
P4	775	28.9	9.5	800	28.7	9.3
P5	744	34.8	12.5	751	35.9	13.1
P6	736	43.3	15.6	711	44.9	17.1
Total	2255	35.5	14.0	2262	36.2	14.9

Maximum score = 100%

Table 30 also shows that whereas the pupils in P5 and P6 performed better in the final evaluation survey than their counterparts in the mid-term baseline survey, the performance of

P4 pupils in the final evaluation was weaker than those in the mid-term baseline survey. It seems the higher ability range of P4 pupils in the mid-term baseline as depicted by the standard deviation (9.5 compared to 9.3) had imparted positively on the results of the P4 pupils. The variances among the three classes were significantly different ranging from 86.49 in P4 to 292.41 in P6. Analysis of variance (ANOVA) shows that the means on the upper primary mathematics achievement test were significantly different among the three classes, $F(2, 2259) = 274.70$, $p < 0.05$. Follow-up statistical tests (post-hoc comparisons) were conducted to evaluate pair-wise differences among the mean scores of the three classes. The results of the post hoc comparisons indicated that there were significant differences in the mean scores between any two classes in favour of the higher one.

The results of the achievement test in mathematics by gender reported in Table 31 shows that male pupils performed significantly better at the 0.05 level of significance than female pupils in only the final evaluation survey. In the mid-term baseline survey, there was no significant difference at the 0.05 level of significance even though the males had a slightly higher mean score than their female counterparts. Also the performance of males in the final evaluation test was higher than their counterparts in the mid-term baseline test. This was not the case for females where the performance was about the same. There were no significant differences at 0.05 level in the range of abilities in male and female pupils. Analysis using t-test also showed no significant difference in achievement between males and females in the mid-term baseline survey.

Table 31: Overall performance in mathematics of upper primary school pupils by gender

Gender	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Female	1104	35.4	13.8	1133	35.3	14.6
Male	1151	35.7	14.2	1129	37.1	15.1
Total	2255	35.5	14.0	2262	36.2	14.9

4.5.2 Junior Secondary School

The JSS mathematics achievement test consisted of 43 multiple-choice items. The response options for 40 of the items ranged from A to D whilst the option for three items was ranged from A to E. Out of the 43 items, 29 carried two marks each whilst 14 carried three marks each making a total of 100 marks for the test. The standard of 32 out of the 43 questions, were at the level of the JSS1 pupils whilst 39 out of the 43 questions were at the level of the JSS2 pupils. There were additional two questions which were at the level of JSS3 pupils. The overall performance of the pupils in the JSS mathematics achievement test is represented in Table 32.

Table 32: Overall performance of JSS pupils in mathematics achievement test by district

District	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Akuapem North	584	33.7	12.1	595	36.9	13.2
Tamale	425	35.8	15.5	430	33.6	15.9
Adansi West	504	31.9	10.4	527	33.2	11.2
Total	1513	33.7	12.8	1552	34.7	13.5

Maximum score = 100%

The results in Table 32 indicate that the mean score of 34.7% obtained by pupils in the final evaluation survey was significantly higher than the 33.7%, t (3063) = 2.17, p<0.05, obtained by their counterparts in the mid-term baseline. Of the three districts, JSS pupils in Adansi West had the lowest mean score of 33.2% with Akuapem North and Tamale Districts scoring a mean of 36.9% and 33.6% respectively in the final evaluation survey. Whereas in the mid-term baseline survey, Tamale District performed better in the mathematics achievement test compared to the other two districts, in the final evaluation survey, Akuapem North District performed better than Tamale District. There is therefore no clear cut trend in the performance of the districts across surveys.

Also in each district pupils used in the final evaluation survey performed better than their counterparts in the mid-term baseline survey with the exception of Tamale District where the mean score fell from 35.8% to 33.6%. The standard deviation in Tamale was the highest in both surveys suggesting a wider ability range of schools in the district compared to the others. This same trend was observed for the primary schools.

Analysis of variance (ANOVA) shows that the mean scores on the JSS mathematics achievement test were significantly different among the three districts, F (2, 1549) = 12.78, p <0.05. Follow-up statistical tests were conducted to evaluate pair wise differences among the

mean scores. The results of this post hoc comparisons indicated that there were no significant differences in the mean scores between Tamale and Adansi West Districts. The differences between Akuapem North and Tamale Districts and between Akuapem North and Adansi West Districts were however, significantly different at the 0.05 level

Table 33: Overall performance of JSS pupils in mathematics achievement test by class

Class	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
JSS1	758	31.5	11.2	805	32.0	11.2
JSS2	755	36.0	13.8	747	37.6	15.1
Total	1513	33.7	12.8	1552	34.7	13.5

Maximum score = 100%

The overall performance of pupils in the JSS mathematics achievement test as presented in Table 33 shows a mean score of 34.7% in the final evaluation survey. This is higher than the mean score of 33.7% obtained by pupils in the mid-term baseline survey. The results by class as reported in Table 32 shows that JSS2 pupils performed better than JSS1 pupils in both mid-term baseline and final evaluation surveys. This is to be expected since the JSS2 pupils were more matured and had more exposure to the teaching and learning of science than pupils in JSS1. Also whereas 25.6% of the questions in the mathematics achievement test were above the level of the JSS1 pupils, only 4.7% of the questions were above the level of JSS2 pupils. The variances among the two classes ranged from 125.44 to 228.01 and were significantly different at the 0.05 level. Independent samples t-test showed that JSS2 pupils' performance in the mathematics achievement test was significantly better than that of JSS1 pupils, t (1550) = -8.28, p<0.05.

The results of the performance test in mathematics by gender reported in Table 34 shows that male pupils performed significantly better at the 0.05 level of significance than female pupils in both the mid-term baseline and final evaluation surveys. The performance of males and

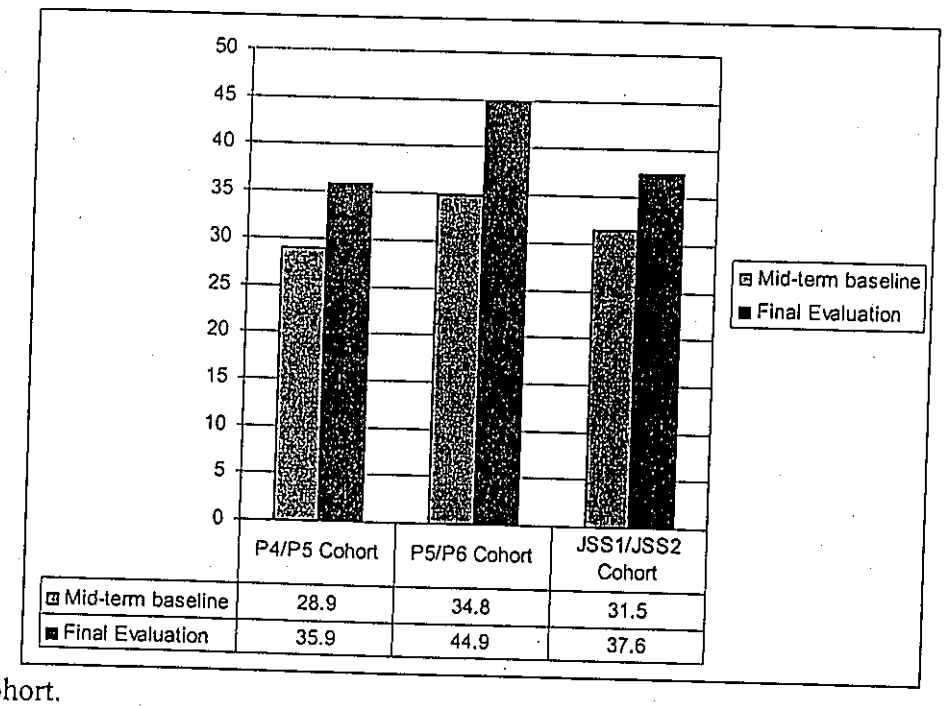
females in the final evaluation test was higher than their counterparts in the mid-term baseline test. There were no significant differences in the range of abilities in male and female pupils in the mid-term baseline survey. However, in the final evaluation survey there was a significance difference in the range of abilities of male and female pupils as indicated by the range of standard deviations in Table 34. Differences between males and females in the final evaluation survey were therefore wider.

Table 34: Overall performance of JSS pupils in mathematics achievement test by gender

Gender	Mid-term Baseline			Final Evaluation		
	N	Mean Score	Standard Deviation	N	Mean Score	Standard Deviation
Female	691	32.9	12.4	711	33.3	12.3
Male	822	34.3	13.0	841	35.9	14.3
Total	1513	33.7	12.8	1552	34.7	13.5

4.5.3 Comparison of same pupils in mid-term baseline and final evaluation surveys in mathematics

At the time of the final evaluation survey, P4 pupils who took part in the mid-term baseline survey had moved to P5. Those in P5 during the mid-term baseline survey had moved to P6 and those in JSS1 had moved to JSS2. Figure 10 shows the performance of the same cohort of pupils in the same tests a year later. It can be seen from the figure that the P5/P6 cohort had the highest improvement in performance followed by the JSS1/JSS2 cohort and then the P4/P5 cohort.



	P4/P5 Cohort	P5/P6 Cohort	JSS1/JSS2 Cohort
Mid-term baseline	28.9	34.8	31.5
Final Evaluation	35.9	44.9	37.6

Figure 10: Performance of the same cohort of pupils in the mid-term baseline and final evaluation in the STM mathematics achievement test.

Figure 10 compares the mean scores in mathematics of (a) P4 mid-term baseline pupils and the same pupils in P5 at the time of the final evaluation, (b) P5 mid-term baseline pupils and the same pupils in P6 at the time of the final evaluation and (c) JSS1 mid-term baseline pupils

and the same pupils in JSS2 at the time of the final evaluation. The graph shows improvements in achievement in mathematics in all the three cohorts with the P5/P6 cohort recording the highest gain. Independent t-test analysis of the mean scores between P4 pupils in the mid-term baseline and the mean scores of the same pupils in P5 at the final evaluation survey shows that there were significant improvements, $t(1529) = -12.01$, $p<0.05$, in their performance over the period. The same applies to the other cohorts ($t(1448) = -12.83$, $p<0.05$ for P5/P6 cohort; $t(1503) = -18.07$, $p<0.05$ for JSS1/JSS2 cohort).
The performance of the P5/P6 cohort was consistent across science and mathematics as they had the highest significant improvements in both subjects.

4.6 Percentage of Pupils which Achieved the PDM target in Science and Mathematics in the Final Achievement Test

The standard scores for upper primary science and mathematics were fixed at the 35th percentile whilst that of JSS was fixed at the 30th percentile in baseline test. Since the achievement tests were modified after the mid-term review, new standard scores were fixed at 40th percentile for upper primary school pupils and 35th percentile for JSS pupils at the mid-term baseline. H the short term PDM target for the STM project was that 45.0% of upper primary school pupils in the three project districts would obtain standard scores of 36.0% in the mathematics and science achievement tests by year five. Table 35 shows the proportion of pupils achieving the PDM targets in the midterm baseline and final evaluation. From the table, it can be seen that the PDM target was achieved for science but not for mathematics as 47.1% of upper primary school pupils obtained the PDM target of 36.0% in science over and above the target of 45.0%. In the case of mathematics, 42.1% instead of the targeted 45.0% of the upper primary school pupils were able to obtain the standard PDM target score of 36.0% in the mathematics achievement test.

Table 35: Proportion of upper primary pupils achieving PDM target for science and mathematics

	Science	Mathematics
Mid-term baseline	41.7	42.4
Final Evaluation	47.1	42.1

The short term PDM target for the STM project was that 40.0% of JSS pupils in the three project districts would obtain standard scores of 36.0% in the mathematics and 43.0% in science achievement tests by year five. Table 36 shows the proportion of pupils achieving the PDM targets in the mid-term baseline and final evaluation. From the table, it can be seen that the PDM target was achieved for mathematics but not for science as 40.7% of JSS pupils obtained the PDM target of 36.0% in mathematics over and above the target of 40.0%. In the case of science, 37.2% instead of the targeted 40.0% of the JSS pupils were able to obtain the standard PDM target score of 43.0% in the science achievement test.

Table 36: Proportion of JSS pupils achieving PDM target for science and mathematics

	Science	Mathematics
Mid-term baseline	35.1	36.6
Final Evaluation	37.2	40.7

4.7 Comparison between the Performance of Pupils on the same TIMSS questions in the Mid-term Baseline and Final Evaluation Tests

The TIMSS questions which formed part of the mathematics and science achievement tests were mainly problem solving questions. The purpose for including TIMSS questions in the achievement tests was to find out how pupils will perform in these questions as most of the traditional questions leading to the BECE have concentrated mostly on knowledge and comprehension levels of Bloom's taxonomy of educational objectives. In this section the performance of pupils in the mid-term baseline survey are compared with pupils of the final evaluation survey to see whether generally, there were significant improvements in the area of problem solving since the STM INSET put some emphasis on this area.

Table 37 shows the results of the performance of upper primary school pupils in the mid-term baseline and final evaluation surveys in science and mathematics. The performance of pupils in both mathematics and science TIMSS questions were below average. This could be attributed to the fact that some of the questions were above the standard of the pupils especially in P4 and P5. The table shows that in science, pupils in the final evaluation survey obtained a mean score of 15.82 compared to 14.77 by their counterparts in the mid-term baseline. The result in mathematics was the opposite, with the mid-term baseline pupils performing better than their counterparts in the final evaluation survey. Independent t-test analysis of the mean scores between pupils in the mid-term baseline and those in the final evaluation surveys indicate that there was a significant difference at the 0.05 level in pupils' performance in science but not in mathematics. The performance in TIMSS questions in mathematics was therefore about the same. The standard of some of the questions were however, higher than the level of the students and this might have accounted for the generally low performance.

Table 37: Performance of upper pupils in TIMSS questions in mathematics and science

		Science				Mathematics			
		N	Mean	SD	t	N	Mean	SD	t
P4/P5 cohort	Mid-term baseline	2260	14.77	6.89	-5.05*	2255	5.04	3.63	0.656
	Final evaluation	2262	15.82	7.68		2262	4.97	3.73	

*Significant, $p<0.05$, maximum score for science = 49; mathematics = 17

Table 38 shows the results of the performance of JSS pupils in the mid-term baseline and final evaluation surveys in science and mathematics TIMSS questions. The table shows that in mathematics, the pupils in the final evaluation survey performed better with a mean score of 8.46 compared to 8.12 by their counterparts in the mid-term baseline. The result in science was the opposite, with the mid-term baseline pupils performing better than their counterparts in the final evaluation survey. Independent t-test of the mean scores between pupils in the mid-term baseline and pupils in the final evaluation surveys indicate that there was a significant difference in pupils' performance in both science, and mathematics.

Table 38: Performance of JSS pupils in TIMSS questions in mathematics and science

	Science				Mathematics			
	N	Mean	SD	t	N	Mean	SD	t
Mid-term baseline	1525	12.98	6.22	3.385*	1513	8.12	4.60	-2.032*
Final evaluation	1552	12.25	5.71		1552	8.46	4.75	

*Significant, $p<0.05$, maximum score for science = 32; mathematics = 26

Correlation between English language and Science

At the mid-term baseline survey, it was hypothesised that the low performance of pupils on the achievement tests particularly in science could be due partly to the inability of the pupils to read and understand the questions. It was therefore necessary to see whether there was any correlation between pupils' performance in English language and Science. The importance of English language in the school curriculum and the fact that various assertions have been made concerning its role in the study of science and other subjects makes it important to explore this relationship. The mid-term baseline survey established a moderately significant positive correlation between achievement in English language and science.

In this final evaluation, Pearson Product-Moment Correlation Coefficient (r) was computed for the two variables (scores English language and science) at the 0.05 level of significance. The results showed a positive linear correlation between scores in English language and science, with r-value of 0.686 suggesting a moderate to strong linear relationship. This confirms the findings in the mid-term baseline survey. Thus it can be inferred that pupils who achieved highly in English language test also to achieved highly in science. It is pertinent to note that the science questions given to the pupils required reading and comprehension of the questions. This is where proficiency in English language could play a key role in achievement in the science test.

There was also a positive linear correlation between scores in English language and mathematics, with r-value of 0.589 suggesting a moderate linear relationship. Again as it was in the case of science it can be inferred that pupils who achieved highly in English language are also achieved highly in mathematics. Pearson Product-Moment Correlation Coefficient (r) was computed for the two variables (scores mathematics and science) at the 0.05 level of significance. The results of the correlation analysis showed a positive linear correlation between scores in maths and science, with r-value of 0.642 suggesting a moderate to strong linear relationship. Therefore pupils who achieve highly in mathematics also achieved highly in science.

5.0 Summary of Key Findings

Impact of STM INSET

1. Assessment of upper primary and JSS STM trained teachers by external assessors showed a marked improvement in the writing of lesson notes in all seven areas assessed after the teachers had gone through STM INSET. Changes in scores before and after INSET were highest in the area of TLMs.
2. Assessment of upper primary and JSS STM trained teachers by external assessors showed a marked improvement in lesson presentation in all five areas assessed after the teachers had gone through STM INSET. Changes in scores before and after INSET were highest in the area of TLMs and introduction of lessons. Also Circuit supervisors, headteachers and STM trained teachers were unanimous in asserting that the impact of the STM INSET has brought about marked improvement in the writing of lesson notes, presentation of lessons and the use of TLMs.
3. Giving of exercises in science and mathematics to pupils has improved after teachers went for the STM INSET.
4. Pupils have developed more interest in science and mathematics as a result of changes in instructional delivery and see the subjects as useful.

Performance of pupils in science and mathematics

1. Overall the performance of pupils in upper primary and JSS in the final evaluation survey in mathematics and science was better than in the mid-term baseline survey
2. The results of the survey show that generally, primary and JSS pupils made improvements in achievement as they moved to higher grade levels.
3. Generally at both upper primary and JSS, pupils in Akuapem North District performed better in the science and mathematics achievement tests than pupils in Tamale and Adansi West Districts in that order.
4. There were significant differences in the level of achievement in the three districts in science and mathematics for both primary and JSS pupils.
5. The same cohort of pupils (P4/P5, P5/P6 and JSS1/JSS2) who took the mid-term baseline recorded significant gains in their performance in the final evaluation achievement tests in science and mathematics.
6. Upper primary and JSS level males pupils performed better than their female counterparts in both science and mathematics achievement tests in the final evaluation survey
7. There was a moderate to strong linear correlation between performance in English language and science, English language and mathematics, and science and mathematics at both primary and JSS levels. This means that performance in English language has a positive linear relationship with performance in mathematics and science and also performance in science has a positive linear relationship with performance in mathematics.

Achievement of PDM targets science and mathematics

1. The project was able to achieve the PDM target of 45.0% of upper primary pupils obtaining 36.0% in science achievement test. The target for the mathematics achievement test was not achieved.
2. The project was able to achieve the PDM target of 40.0% of JSS pupils achieving 36.0% in mathematics achievement test. The target for the science achievement test was not achieved.

Comparison of mid-term baseline and final evaluation survey in the same TIMSS questions

1. There was a significant improvement in performance of upper primary pupils in the TIMSS questions in science but not in mathematics in the final evaluation survey compared to the mid-term baseline survey. However, mean scores in both science and mathematics were less than half the total scores.
2. There was a significant improvement in performance of primary science and JSS mathematics in the TIMSS questions in the final evaluation survey compared to Mid-Term Baseline survey.

6.0 Conclusion

The key findings of this final evaluation survey leave little doubt that the GES-JICA STM Project has had tremendous impact on upper primary and JSS teachers who participated in the STM INSET. Findings of the survey have shown considerable improvement in lesson notes preparation, lesson presentation and development and use of teaching and learning materials. To a large extent therefore the project has achieved its purpose of improving the capacity of STM/INSET-trained teachers for delivering STM in the three project areas.

Also the short term goal of the GES-JICA STM Project improving the educational achievement of pupils at upper primary and JSS in science and mathematics were achieved in science for upper primary pupils and in mathematics by JSS pupils.

7.0 Suggestions/Way Forward

(a) To sustain the impact of the STM project, the lack of funds for organising school-based INSET need to be addressed. It is important to note that teachers will go back to the familiar traditional approaches to the teaching of science and mathematics if the good practices introduced by the STM project are not given adequate support particularly at the school level to consolidate the skills acquired by teachers. To be able to do this, it is important for more effort and time to be invested at the school level by the GES to support teachers. Initially, teachers may lack the confidence and authority to be resource persons at school level INSET particularly for younger staff. It is therefore important that more capable and resourceful STM trained teachers are identified and supported to organise a few initial INSET at the school level for them to gain experience.. There is also the need for greater dialogue between headteachers, circuit supervisors and district officers on the good practices of the STM project and how teachers can be supported at the school level to sustain it. This will help to address the problem of headteachers' and circuit supervisors' expectations sometimes being different from the ones that are promoted by STM INSET.

(b) The good practices teachers had acquired require a culture of teaching and learning that allow for more time on task by pupils in order to develop the appropriate concepts especially in science. However, this raises the problem of teachers' complaints of having to teach several different lessons especially in the upper primary school. Teachers' workload therefore becomes an issue that is likely to affect effective instructional delivery. This will make it difficult to implement fully the new strategies and skills for teaching which are child-centred and activity oriented. One way of dealing with this problem as suggested by some teachers is to introduce subject teaching for science and mathematics particularly at the upper primary school.

(c) One of the key successes of the STM INSET has been the development and use of TLMs. However, there is some cost element involved in the extensive use of TLMs for lessons in science and mathematics. Also even though teachers can improvise some items through the use of available materials from their surroundings, some materials for improvisation must be purchased (e.g. cardboards, felt pens, magnets, measuring cylinders etc). Some improvised materials also have a shorter life span and may need to be replaced as often as possible. Schools may therefore need science and mathematics kit boxes to be supplied by the MOE to both primary schools and JSS and replenished from time to time.

(d) The study showed that boys performed better than girls in both science and mathematics. Therefore the need for explore through INSET teaching methodologies which could address this imbalance.

(e) The universities must be encouraged to lend support in the organisation of INSET for basic school teachers due to their expertise in the training of basic school teachers.

5. Major Events of STM project

ANNEX 5

Major Events of STM Project

Year	Month	Dine	Major Activity
1996			fCUBE programme launched(1996-2005)
1997	9	28	Basic Study Team dispatched(up to 12th Oct)
1998	10	25	Preliminary Study Team dispatched(10th Nov)
1999	8	10	Short-term Study Team dispatched(up to 29th Aug)
1999	10	3	Implementinion Study Team dispatched(up to 16th)
2000	3	1	Launching day of STM Project
	3		STM started work in Literacy house office(temporaly until renovinion of office at TED)
	4	28	Working Committee Meeting
	5	3	Working Committee Meeting
	6	8	Baseline survey 2000 Meeting(Survey started)
	7	14	1st Joint Coordinining Committee Meeting
	8	18	Working Committee Meeting
	9	15	Working Committee Meeting
	11	30	Move STM office to TED Office(after renovation)
	11	14	Baseline survey presentation workshop at UCC
	11	16	Baseline survey presentation workshop at GNAT
2001	1	12	Working Committee Meeting in PTC
	1	30	Headteacher seminar in Akuapem North District
	2	6	JSS INSET Science (up to 8th) in Akuapem North
	2	13	JSS INSET Maths (up to 15th)in Akuapem North
	2	16	Working Committee Meeting in TED / Seminar by short-term experts
	2	20	Primary INSET Science (up to 22nd) in Akuapem North
	2	23	2nd Joint Coordinining Committee Meeting
	2	27	Primary INSET Maths (up to 1st March) in Akuapem North
	3	13	JSS INSET Science (up to15th) in Akuapem North
	3	20	JSS INSET Maths (up to 22nd)in Akuapem North /Visit of JICA Nigeria Office
	3	24	PCM Workshop to revise PDM
	3	27	Primary INSET Science (up to 29th) in Akuapem North
	4	1	Consultation Team from JICA HQ arrives in Ghana
	4	2	Science and Mathematics Fair in Akuapem North
	4	3	Primary INSET Maths (up to 5th) in Akuapem North
	4	5	Working Commttee in TED
	5	8	Primary INSET Science in Akuapem North(up to 10th)
	5	15	Primary INSET Maths in Akuapem North(up to 17th)
	5	22	Primary INSET Science in Akuapem North(up to 24th)

ANNEX 5

Major Events of STM Project

Year	Month	Dine	Major Activity
	5	28	Working Committee Meeting
	5	29	Primary INSET Maths in Akuapem North(up to 31st)
	6	12	Primary INSET Science in Akuapem North(up to 14th)
	6	19	Primary INSET Maths in Akuapem North(up to 21st)
	6	26	Primary INSET Science in Akuapem North(up to 28th)
	7	2	Working Committee Meeting
	7	3	Primary INSET Maths in Akuapem North(up to 5th)
	9	12	Working Committee Meeting
	9	16	Technical exchange visit to SMASSE in Kenya(up to 23rd)
	10	2	INSET JSS Science in Akuapem North(Up to 4th)
	10	9	INSET JSS Maths in Akuapem North(Up to 11th)
	10	16	INSET Primary Science in Akuapem North(Up to 18th)
	10	17	Working Committee Meeting
	10	23	INSET Primary Maths in Akuapem North(Up to 25th)
	11	2	3rd Joint Coordinining Committee Meeting
	11	6	INSET JSS Science in Akuapem North(Up to 8th)
	11	13	INSET JSS Maths in Akuapem North(Up to 15th)
	11	20	INSET Primary Science in Akuapem North(Up to 21st)
	11	27	INSET Primary Maths in Akuapem North(Up to 29th)
	12	5	STM Strinegic Planning Committee
2002	1	16	Headteacher seminar in Tamale
	1	17	Headteacher seminar in Tamale
	1	29	Primary 4 INSET Science in Akuapem North(up to 31st)
	2	5	JSS INSET in Tamale(up to 13rd)
	2	19	Primary INSET Mathematics in Akuapem North(up to 21st)
	2	26	Primary 4 INSET Science in Akuapem North(up to 28th)
	3	10	Primary 6 INSET in Tamale(up to 20th)
	3	25	Primary INSET Mathematics in Akuapem North(up to 27th)
	4	3,4	Science and Mathematics fair in Akuapem North
	5	28	Primary 4 INSET in Akuapem North(up to 30th)
	6	4	Primary INSET in Tamale(up to 12th)
	6	18	Primary 4 INSET in Akuapem North(up to 20th)
	6	24	Mid-term review survey started(up to 3rd July)
	6	28	4th Joint Coordinining Committee Meeting
	7	15	1st trial visit to school-based INSET in Akuapem North(5 schools)

ANNEX 5

Major Events of STM Project

Year	Month	Dine	Major Activity
	8	31	One day INSET in Kadjebi(Volta Region)(on request)
	9	25	Headteacher seminar in Adansi West
	9	27	Technical exchange visit to MSSI in South Africa(up to 4th Oct)
	10	15	Primary INSET in Tamale(up to 17th)
	10	22	Primary INSET in Adansi West(up to 24th)
	11	12	Primary INSET in Tamale(up to 14th)/Primary INSET in Adansi West(up to 14th)
	11	28	Mid-term review(up to 11th December)
	12	2	5th Joint Coordinining Committee Meeting
	12	20	Working Committee Meeting
2003	1	14	Induction Training in Primary in Akuapem North(up to 16th)
	1	21	Induction Training in JSS in Akuapem North(up to 23rd)
	2	4	JSS INSET in Adansi West(up to 6th)
	2	10	1st Coordininors' Meeting
	2	18	Induction Training in JSS in Akuapem North(up to 20th)
	2	22	Technical exchange from SMASSE Project in Kenya
	2	25	JSS INSET in Adansi West(up to 27th)
	3	1	WSSD follow-up meeting in Kenya
	3	11	Induction Training in Primary in Akuapem North(up to 13th)
	3	19	Working Committee Meeting
	5	6	Primary INSET in Tamale(up to 15th)
	5	19	2nd Coordininrors' Meeting
	5	27	Induction Training in Primary in Akuapem North(up to 29th)/INSET in Adansi West(up to 29th)
	5	30	Mid-term Baseline Achievement Test(up to 13rd June)
	6	17	INSET in Adansi West(up to 19th)
	6	18	Induction Training in Primary in Akuapem North(up to 20th)
	6	30	3rd Reginal Conference of SMASSE(Strengthing Mathematics and Science educinion in Secondary Education)-WECSA(Western, Eastern, Central and Southern Africa)
	7	11	6th Joint Coordinining Committee
	8	4,5,6	Science and Mathematics fair in Akuapem North
	9	23	Ajumako Review Workshop(up to 26th)
	9	26	3rd Coordininors' Meeting
	10	6	Headteacher seminar in preparinion for Curriculum Leader Training in Akuapem North
	10	7	1st session of Curriculum Leader Training in Akuapem North(up to 9th)
	10	21	Primary INSET in Tamale(up to 23rd)
	10	28	Primary INSET in Tamale(up to 30th)/ 2nd binch of JSS INSET in Adansi West
	11	10	Headteacher seminar in Tamale

ANNEX 5

Major Events of STM Project

Year	Month	Dine	Major Activity
	11	11	Primary INSET in Tamale(up to 13rd)/ 2nd binch of JSS INSET in Adansi West
	11	14	Headteacher seminar in Adansi West
	11	18	Primary INSET in Tamale(up to 20th)
	11		Evaluinion Mission of Education Sector in Ghana from Japanese Ministry of Foreign Affiars
	12	8	Bunso STM manual review workshop(up to 12th)
	12	9,11	4th coordininors' meeting
2004	1	7	2nd session of Curriculum Leader Training in Akuapem North(up to 9th)
	1	13	Induction Training in Primary in Akuapem North(up to 15th)
	1	20	JSS INSET in Tamale(up to 29th) /Induction Training in JSS in Akuapem North(up to 22nd)
	1	21	Discussion with Districts and TTCs(Tamale/Adansi West) on the future consolidinion
	1	26	One day meeting with Regional managers of religious educinion unit in Tamale
	2	3	INSET institutionalizinion Committee(in TED)
	2	6	7th Joint Coordinining Committee Meeting
	2	10	Primary INSET in Adansi West(up to 12th)/Induction Training in Primary in Akuapem North(up to 12th
	2	24	Primary INSET in Adansi West(up to 26th)/Induction Training in JSS in Akuapem North(up to 26th)
	3	1,2	Circuit Supervisor Orientinion in Adansi West
	3	9	Primary INSET in Adansi West(up to 12th)
	3	10	Primary INSET in Tamale(up to 18th)
	3	16	Primary INSET in Adansi West(up to 26th)
	3	23,24	Circuit Supervisor Orientinion in Akuapem North
	4	1	5th Coordininors Meeting /Equipment Maintenance Training in Accra
	4	14	Preparinory Workshop for National workshop (up to 16th)
	4	19	National Workshop for 38 TTC tutors in the teaching of science and Mathematics(up to 23rd)
	5	5	3rd session of Curriculum Leader Training in Akuapem North(up to 7th)
	5	18	Primary INSET in Tamale(up to 27th)
	5	29	4th Regional Conference of SMASSE-WECSA in South Africa(up to 7th June)
	6	4	Science and Mathematics quiz and fair in Adansi West
	6	10,11	Science and Mathematics fair in circuit level in Tamale
	6	17	Working Committee Meeting
	6	21	Data collection for final evaluinion(up to 17th July)
	9	19	Final Evaluinion (up to 8th Oct)
	10	1	8th Joint Coordinating Committee