Volume 2

Volume Two

Appendices

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Appendix 1

Diagrams, Tables of Results and ESP and LDC Teachers Replies to Section 4 of STSIS Questionnaire.

Figure 3.2

Relationship Between Number of Pupils Entering for O Level Biology and Percentage Passing (1973 - 1978)

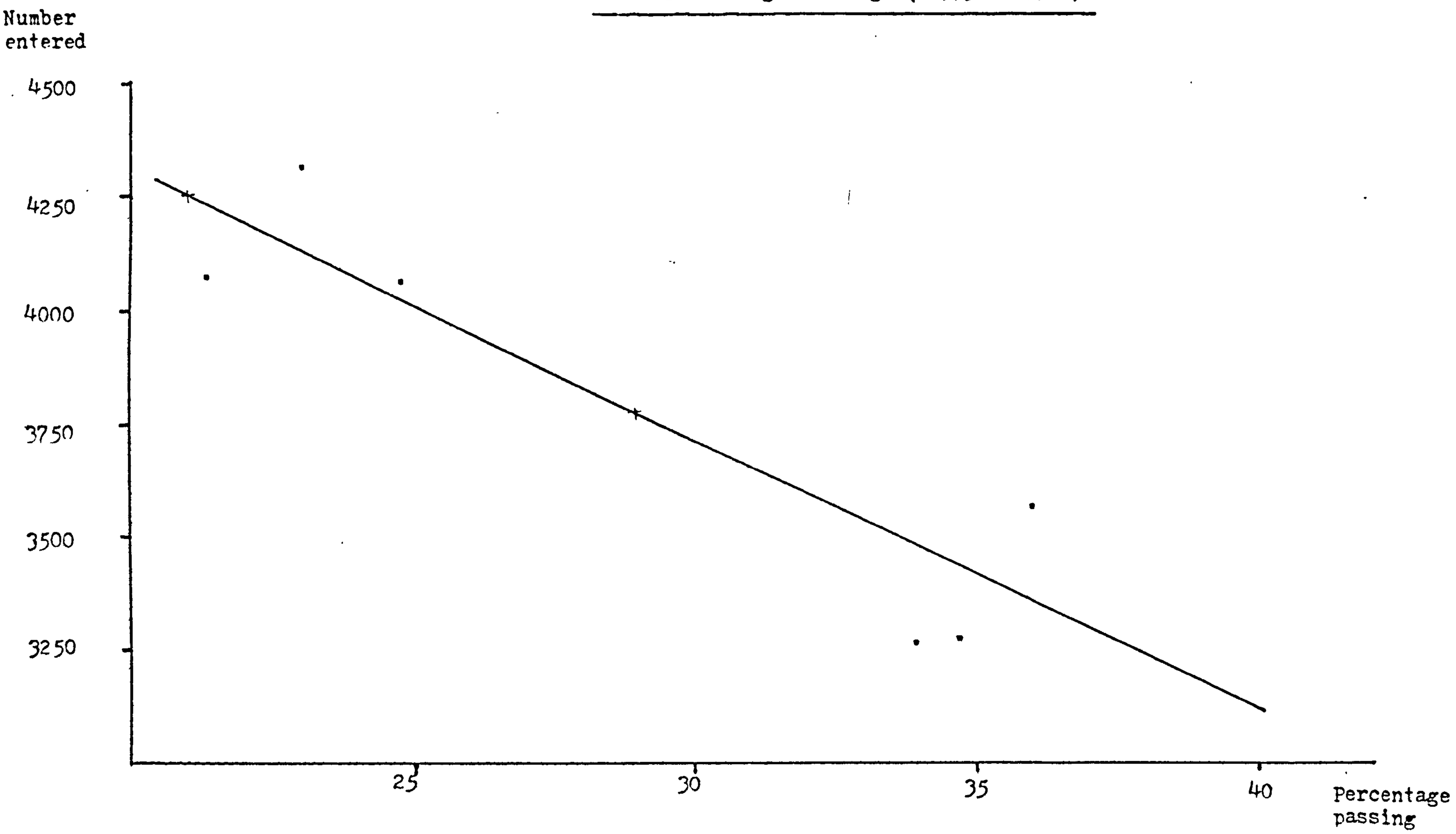

Figure 3.3

Relationship Between Number of Pupils Entering for O Level Chemistry and Percentage Passing (1973 - 1978)

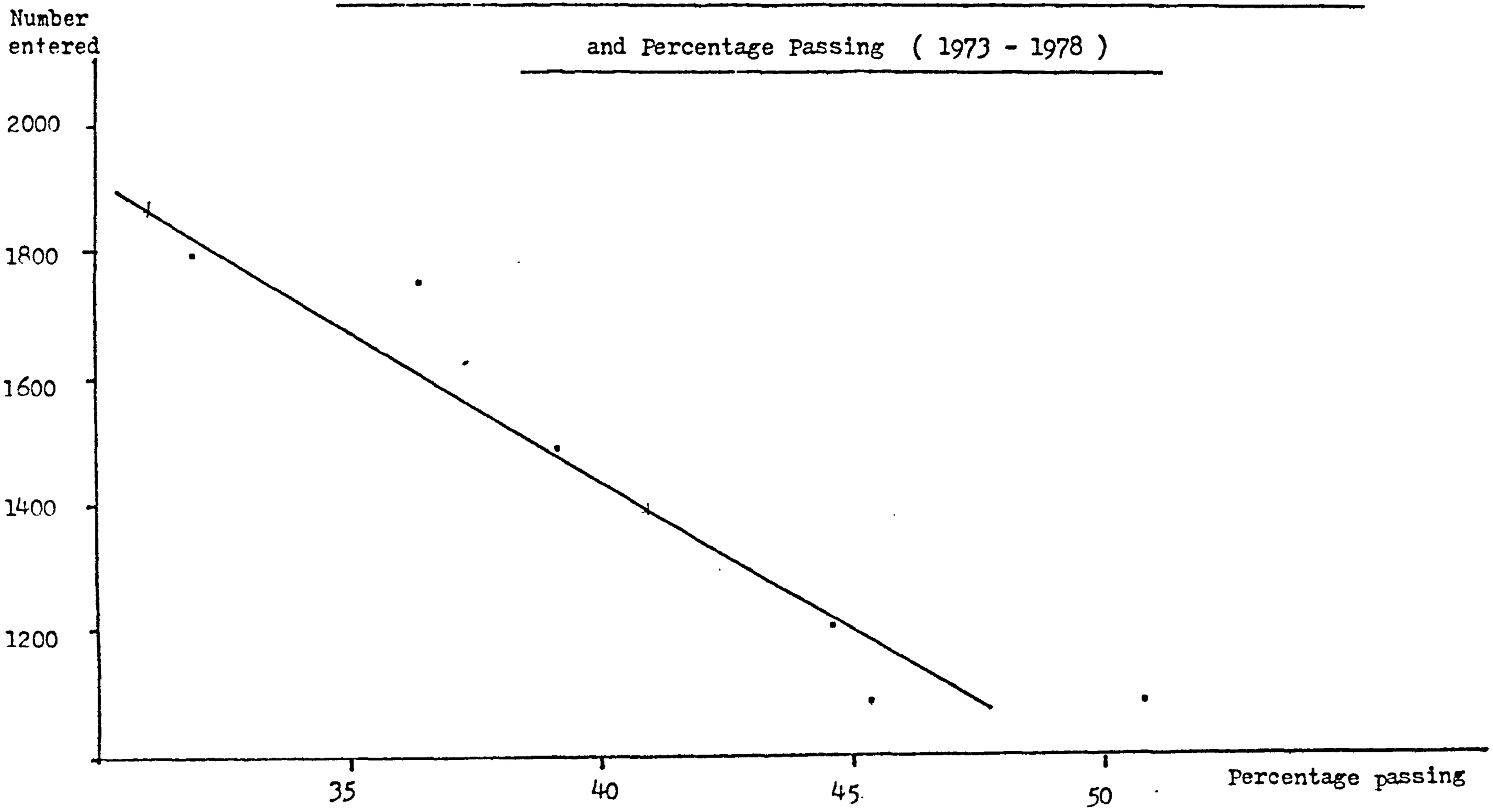

Figure 3.4

Relationship Between Number of Pupils Entering for O Level Physics and Percentage Passing (1973 - 1978)

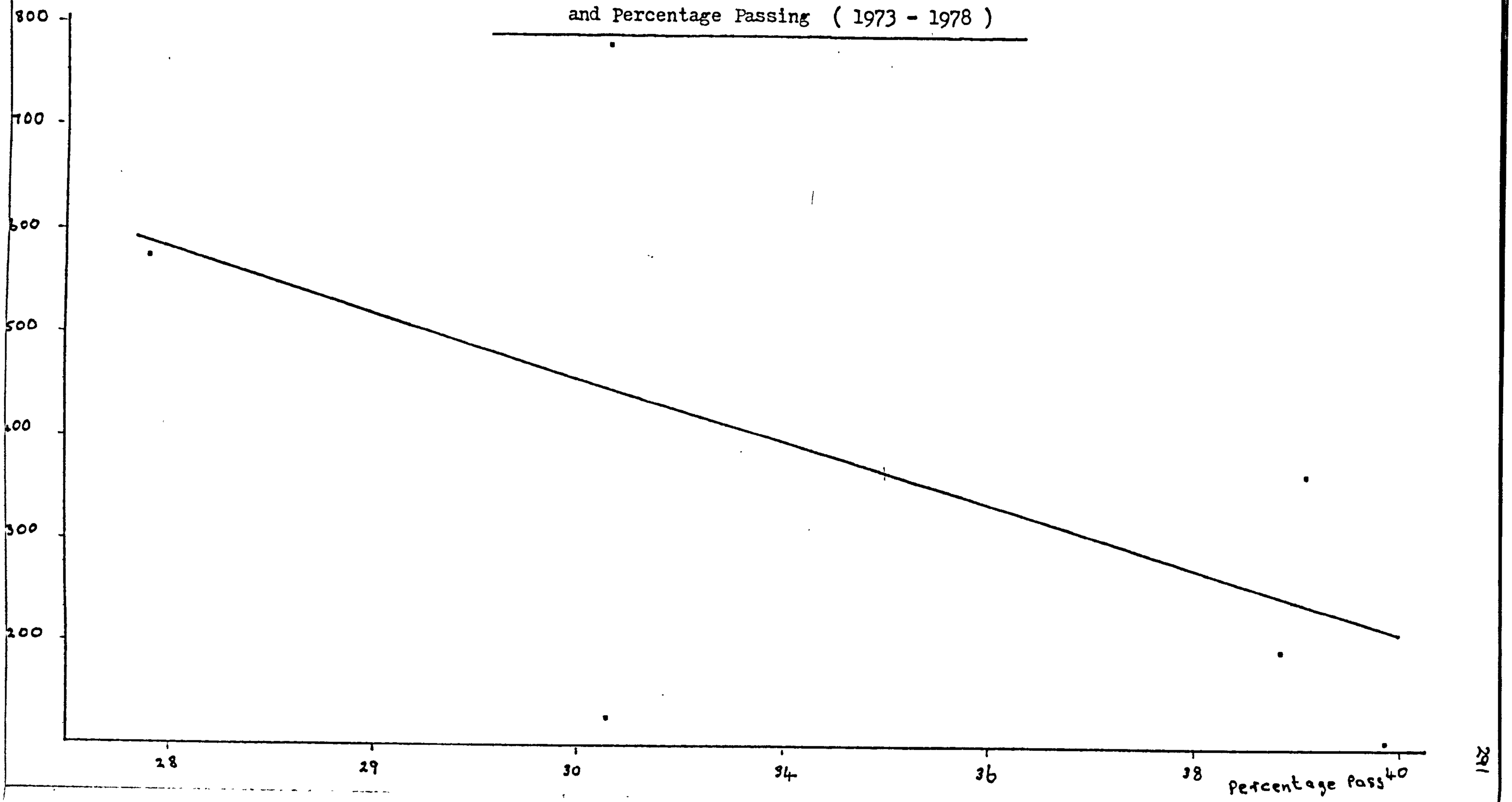

Table 5.6

A Quantitative Classification of ESP Written Materials

(percentages shown in brackets)

Unit No.		Assignable Category					
		Content	Science Methods	Students' Tasks	Relevance	Self-evaluation	Total
1	No. of pages	37 (31.4)	23 (19.5)	39 (33.1)	10 (8.5)	9 (7.6)	118 (100)
2	No. of pages	16 (15.1)	13 (12.3)	34 (32)	33 (31.2)	10 (9.4)	106 (100)
3	No. of pages	108 (82.4)	2 (1.5)	13 (9.9)	5 (3.8)	3 (2.3)	131 (100)
4	No. of pages	76 (82.6)	3 (3.3)	8 (8.7)	2 (2.2)	3 (3.3)	92 (100)
5	No. of pages	47 (64.4)	1 (1.4)	16 (21.9)	3 (4.1)	6 (8.2)	73 (100)
6	No. of pages	142 (82)	0 (0)	28 (16.2)	0 (0)	3 (1.7)	173 (100)
7	No. of pages	81 (71.7)	0 (0)	25 (22)	3 (2.6)	4 (3.5)	113 (100)
8	No. of pages	67 (78.8)	0 (0)	9 (10.6)	4 (4.7)	5 (5)	85 (100)
9	No. of pages	128 (74.9)	0 (0)	28 (16.4)	15 (8.8)	0 (0)	171 (100)
10	No. of pages	57 (59.4)	3 (3.1)	29 (30.2)	7 (7.3)	0 (0)	96 (100)
11	No. of pages	71 (76.3)	0 (0)	12 (12.9)	7 (7.5)	3 (3.2)	93 (100)
12	No. of pages	120 (90.2)	0 (0)	9 (6.8)	1 (0.8)	3 (2.3)	133 (100)
13	No. of pages	85 (70.2)	6 (5.0)	27 (22.3)	3 (2.5)	0 (0)	121 (100)

... cont.

Table 5.6 continued

Unit No.		Assignable Category					
		Content	Science Methods	Students' Tasks	Relevance	Self-evaluation	Total
14	No. of pages	47 (77)	0 (0)	2 (3.3)	2 (3.3)	10 (16.4)	61 (100)
15	No. of pages	54 (90)	2 (3.3)	3 (5.0)	1 (1.7)	0 (0)	60 (100)
16	No. of pages	83 (83)	0 (0)	14 (14)	1 (1)	2 (2)	100 (100)
17	No. of pages	67 (83)	0 (0)	10 (12)	0 (0)	4 (5)	81 (100)
18	No. of pages	39 (76)	0 (0)	1 (2)	11 (22)	0 (0)	51 (100)

Table 5.9

A Key-word Analysis of Students' Reports on ESP Units 1-8

Students' Description \ Unit No.	1	2	3	4	5	6	7	8
Satisfactory	7	1	2	12	9	6	7	2
%	(21)	(3)	(6)	(36)	(27)	(18)	(21)	(6)
Clear (well presented)	11	8	0	6	12	2	6	11
%	(33)	(24)	(0)	(18)	(36)	(6)	(18)	(33)
Interesting	17	23	6	7	8	13	15	23
%	(52)	(70)	(18)	(21)	(24)	(39)	(45)	(70)
Easy (simple)	10	5	2	3	8	1	1	5
%	(30)	(15)	(6)	(9)	(24)	(3)	(3)	(15)
Unsatisfactory	0	0	7	0	2	0	0	0
%	(0)	(0)	(21)	(0)	(6)	(0)	(0)	(0)
Unclear (confusing)	1	1	14	3	0	5	4	0
%	(3)	(3)	(42)	(9)	(0)	(15)	(12)	(0)
Boring	1	1	0	1	1	1	5	0
%	(3)	(3)	(0)	(3)	(3)	(3)	(15)	(0)
Difficult	1	2	8	6	0	19	7	1
%	(3)	(6)	(24)	(18)	(0)	(58)	(21)	(3)
Too long (too much)	8	1	4	2	8	7	2	0
%	(24)	(3)	(12)	(6)	(24)	(21)	(6)	(0)

Table 5.10

Functional and Descriptive Rankings of ESP Units 1-8

Functional Analysis Rankings					Student Descriptive Rankings						
Content	Tasks	Science Methods	Relevance	Self-evaluation	Satisfactory	Clear	Interesting	Difficult	Too long	Unclear	Easy
1	8	3	7	6	1	5.5	7	4	5.5	4	5
2	7	4	5	7	6.5	8	8	2	4	1	6
3	5	7	8	8	5	7	5	1	3	2	7.5
4	6	7	3	4	6.5	2.5	1.5	6.5	8	7.5	3.5
5	3	7	6	5	3.5	5.5	4	3	5.5	3	7.5
6	4	5	4	2	3.5	2.5	3	6.5	1.5	5.5	1
8	2	2	1	1	8	4	1.5	5	7	5.5	3.5

Table 5.11

Ranked Order Correlations Between Functional and Descriptive Categories in the ESP Units 1 - 8

Functional Categories / Descriptive Categories	Content	Relevance	Self-evaluation	Tasks	Science Methods
Difficult	.57	- .31	- .82 @	- .34	- .26
Interesting	- .68	.65	.59	.63	- .05
Clear	- .62	.63	.82 @	.46	.20
Too long	.26	- .14	- .06	.27	.27
Easy	- .50	.77	.77	.42	.62
Satisfactory	.27	- .44	- .09	- .14	.07
Unclear	.55	- .61	- .77	- .29	- .07

@ Significant at the 5% level

Table 8.2

Self-image Ratings of ESP Teachers

(out of a possible 360)

Teacher	Self-image	
1	323	
2	302	
3	329	
4	324	
5	346	Highest
6	324	
7	200	Lowest
8	232	
9	315	
10	281	
11	290	
12	341	
13	333	
14	323	
15	268	
16	271	
17	287	
18	309	
19	337	
20	270	
21	272	
22	281	
23	279	
24	273	

Mean = 296

Sd = 35.9

N = 24

Table 8.3

Self-image Ratings of Lilian Dewar Trained Science Teachers

(out of a possible 360)

Teacher	Self-image	
1	302	
2	301	
3	321	
4	351	
5	315	
6	344	Highest
7	320	
8	293	
9	261	
10	315	
11	343	
12	305	
13	331	
14	268	
15	268	
16	235	Lowest
17	299	
18	307	
19	331	

Mean	=	306
Sd	=	30.6
N	=	19

Table 8.4

Self-image of ESP Teachers in Nine Areas of Competency

Teacher	Area of Competency								
	Science Methods	Discipline and Management	Instruction and Communication	Organization and Planning	Evaluation and Questioning	Relevance	Rapport	Pupil Development	Science Knowledge
1	36	35	47	37	29	41	35	27	37
2	36	36	39	38	20	40	36	24	33
3	39	37	48	36	26	44	37	25	37
4	35	38	44	35	28	44	36	27	37
5	37	40	50	39	27	47	40	28	38
6	37	35	47	36	28	44	36	25	36
7	21	20	29	24	20	26	24	13	24
8	28	27	34	23	21	21	21	18	29
9	25	34	47	35	24	42	35	28	35
10	28	33	40	31	23	39	32	20	35
11	30	33	40	31	25	40	34	22	35
12	38	38	50	39	30	42	40	27	37
13	39	38	45	39	28	45	37	27	35
14	40	35	42	36	27	45	34	26	38
15	29	30	40	29	23	36	27	21	32
16	27	33	42	32	24	28	29	22	34
17	36	37	39	34	24	35	28	21	33
18	36	37	45	30	28	42	31	22	38
19	37	39	49	38	27	47	37	27	36
20	29	34	38	25	22	36	34	21	32
21	30	28	37	32	23	39	27	22	34
22	32	32	40	29	22	39	29	24	32
23	33	30	42	28	28	38	36	16	28
24	24	32	38	27	25	42	29	26	30
No. of Items	4	4	5	4	3	5	4	3	4
Mean	33	34	42	33	25	39	33	23	34
Sd	5.1	4.5	5.2	5.0	2.9	6.5	4.3	3.9	3.5

Table 8.5

Self-image of Lilian Dewar Teachers in Nine Areas of Competency

Teacher	Areas of Competency								
	Science Methods	Discipline and Management	Instruction and Communication	Organization and Planning	Evaluation and Questioning	Relevance	Rapport	Pupil Development	Science Knowledge
1	34	33	42	30	27	41	35	27	33
2	31	36	42	34	24	38	38	24	34
3	34	36	44	37	25	46	38	27	34
4	37	39	44	35	27	45	34	26	38
5	37	34	40	35	29	42	36	25	36
6	40	38	47	39	27	48	39	29	37
7	36	38	44	35	27	42	36	25	37
8	33	38	42	26	25	36	35	26	33
9	28	32	38	20	23	38	30	22	31
10	40	38	45	34	24	32	36	25	36
11	39	40	48	39	30	48	38	28	33
12	27	38	47	33	30	39	35	26	31
13	33	34	47	37	29	50	38	28	34
14	34	32	38	27	24	34	31	21	27
15	24	30	40	29	23	37	29	26	29
16	14	27	32	22	25	42	31	22	20
17	37	38	46	35	26	39	35	26	36
18	31	33	46	34	30	46	28	20	39
19	38	40	45	35	30	49	33	27	34
No. of Items	4	4	5	4	3	5	4	3	4
Mean	33	35	43	32	27	42	34	25	33
Sd	6.4	3.6	4.0	5.4	2.5	4.9	3.3	2.5	4.4

Table 8.6

Self-image Scores of ESP and LDC Teachers Compared

Competency Area	ESP		LDC		t value for 41df (if greater than 1)
	Mean	(Sd)	Mean	(Sd)	
Science Methods	33	(5.1)	33	(6.4)	-
Discipline and Management	34	(4.5	35	(3.6)	-
Instruction and Communication	42	(5.2)	43	(4.0)	-
Organization and Planning	33	(5.0)	32	(5.4)	-
Evaluation and Questioning	25	(2.9)	27	(2.5)	2.3*
Relevance	39	(6.5)	42	(4.9)	1.6
Rapport	33	(4.3)	34	(3.3)	-
Pupil Development	23	(3.9)	25	(2.5)	1.9
Science Knowledge	34	(3.5)	33	(4.4)	-
Overall Mean	296	(35.9)	306	(30.6)	

* significant at 5% level

Table 8.7

Comparison of ESP and LDC Teachers' Self-image on Thirty-six Skills

Item Number	ESP Mean	ESP Sd	LDC Mean	LDC Sd	t values significant at 5% level
1	8.1	1.6	8.5	1.3	
2	8.1	0.9	8.3	1.3	
3	7.8	1.5	7.7	1.4	
4	8.1	1.7	8.5	2.0	
5	7.9	1.6	6.9	2.0	
6	8.3	1.6	8.1	2.1	
7	8.0	1.7	7.0	2.1	
8	8.8	1.1	8.8	0.9	
9	7.9	1.6	8.2	1.3	
10	8.6	1.5	9.2	1.3	
11	8.4	1.3	8.9	0.9	
12	8.6	1.4	9.1	0.9	
13	7.2	2.0	8.3	1.3	* 2.2 for 41 df
14	8.0	1.5	8.3	1.3	
15	8.5	1.4	8.5	1.5	
16	7.5	2.0	8.1	1.9	
17	7.5	1.7	8.1	1.4	
18	8.6	1.4	8.8	1.4	
19	7.0	2.0	8.4	1.3	* 2.8 for 41 df
20	8.1	1.5	8.2	1.4	
21	8.5	1.2	8.1	1.3	
22	7.8	1.9	8.0	1.6	
23	8.9	1.0	9.1	0.9	
24	8.5	1.4	9.2	1.1	
25	7.8	1.6	8.1	1.1	
26	8.5	1.3	9.1	0.9	
27	8.0	1.5	8.8	1.1	
28	9.4	0.6	9.5	0.7	
29	8.6	1.2	8.1	2.1	
30	9.2	1.3	9.2	1.0	
31	8.8	1.3	8.7	1.3	
32	8.4	1.3	8.8	1.1	
33	8.0	1.6	8.5	1.9	
34	8.6	1.1	9.1	1.0	
35	8.3	1.6	8.5	1.4	
36	8.2	1.4	8.6	1.5	

Table 8.8

ESP Teachers' Image of the Ideal Science Teacher

Teacher	Area of Competency								
	Science Methods	Discipline and Management	Instruction and Communication	Organization and Planning	Evaluation and Questioning	Relevance	Rapport	Pupil Development	Science Knowledge
1	40	40	50	40	30	50	40	30	40
2	39	18	35	27	22	28	20	14	14
3	38	37	49	37	26	45	37	26	35
4	38	39	49	38	30	47	38	28	39
5	40	40	50	40	30	50	39	30	40
6	40	40	50	40	30	50	40	30	40
7	31	22	31	19	23	25	24	14	23
8	28	31	38	32	22	40	27	21	31
9	40	39	50	40	30	50	40	30	40
10	37	37	49	37	29	47	37	23	40
11	37	39	47	38	28	47	37	28	39
12	40	40	50	40	30	50	40	30	40
13	40	40	50	40	30	50	40	30	40
14	40	40	50	40	30	50	40	30	40
15	37	37	48	37	27	47	38	27	39
16	35	35	48	40	28	42	37	28	48
17	40	39	49	38	28	49	36	30	38
18	36	36	40	29	26	42	33	21	33
19	40	39	50	40	29	49	49	29	38
20	40	40	50	40	30	50	39	30	40
21	40	40	49	40	30	50	40	30	40
22	40	40	50	40	30	50	40	30	40
23	39	35	49	38	29	47	39	27	38
24	40	40	50	40	30	50	40	30	40
No. of Items	4	4	5	4	3	5	4	3	4
Mean	38.1	36.8	47.1	37.1	28.2	46.0	36.7	26.9	37.3
Sd	3.0	5.7	5.3	5.2	2.6	6.7	5.4	4.9	6.7

Table 8.9

LDC Teachers' Image of the Ideal Science Teacher

Teacher	Area of Competency								
	Science Methods	Discipline and Management	Instruction and Communication	Organization and Planning	Evaluation and Questioning	Relevance	Rapport	Pupil Development	Science Knowledge
1	36	37	44	38	28	46	39	28	36
2	40	40	49	40	29	50	37	29	39
3	40	39	48	39	30	48	39	28	39
4	40	40	50	40	30	50	40	30	40
5	40	40	50	40	30	50	40	30	40
6	40	40	50	39	29	50	40	30	40
7	40	40	50	39	30	50	40	30	40
8	40	40	45	40	28	45	38	30	40
9	39	40	48	40	30	49	39	30	35
10	36	36	45	35	28	41	36	26	32
11	30	35	49	40	29	48	40	28	35
12	39	39	48	37	28	45	39	28	38
13	40	40	50	40	30	50	40	30	40
14	22	28	42	30	26	45	36	26	25
15	39	39	49	39	29	46	39	29	40
16	32	34	46	36	30	47	31	23	39
17	40	40	49	40	30	50	40	30	39
18	32	35	48	33	28	31	36	24	37
19	36	39	48	38	28	48	36	28	39
No. of Items	4	4	5	4	3	5	4	3	4
Mean	36.8	37.9	47.9	38.0	28.9	46.7	38.2	28.3	37.5
Sd	4.8	3.2	2.2	2.8	1.1	4.6	2.3	2.1	3.8

Table 8.10

Area of Competency	ESP Mean	(Sd)	Rating per item	Rank	LDC Mean	(Sd)	Rating per item	Rank
Science Methods	38.1	(3.1)	9.5	1	36.8	(4.8)	9.2	9
Discipline and Management	36.8	(5.1)	9.2	7	37.9	(3.2)	9.5	4.5
Instruction and Communication	47.1	(5.3)	9.4	2.5	47.9	(2.2)	9.6	2
Organization and Planning	37.1	(7.9)	9.3	4.5	38.0	(2.8)	9.5	4.5
Evaluation and Questioning	28.2	(2.6)	9.4	2.5	28.9	(1.1)	9.6	2
Relevance	46.0	(6.7)	9.2	7	46.7	(4.6)	9.3	8
Rapport	36.7	(5.4)	9.2	7	38.2	(2.3)	9.6	2
Pupil Development	26.9	(4.9)	9.0	9	28.3	(2.1)	9.4	6.5
Science Knowledge	37.3	(6.7)	9.3	4.5	37.5	(3.8)	9.4	6.5

No significant differences at the 5% level between Ideal image in any of the nine areas

Spearman's Rank Order Correlation p = +0.11

(For 8 competencies excluding Science Methods p = +0.61)

Table 8.11

Type of School ESP and LDC Teachers Teach In

	Junior Section Primary	All Age Primary	Community High School	Junior Secondary	Senior High
ESP	0	0	2	19	3
LDC	0	0	2	11	6

Table 8.12

Type of School ESP and LDC Teachers Wish to Teach In

	Junior Section Primary	All Age Primary	Community High School	Junior Secondary	Senior High
ESP	0	0	0	17	7
LDC	0	0	1	4	14

Comparison between numbers of ESP and LDC teachers who,

(i) teach in senior high schools
Chi-square = 1.9 for 1df. Not significant at 5% level

(ii) wish to teach in senior high schools
Chi-square = 8.4 for 1df. Significant at 1% level

(iii) wish to change school type
Chi-square = 1.4 for 1df. Not signiifcant at 5% level

Table 8.13

(a) GCE O Level Passes of ESP Teachers

Note: (X indicates a pass and O indicates that the teacher does not have a pass in this subject)

Teacher	Number of Passes	Phys.	Chem.	Biol.	Maths.	Eng.
1	7	X	X	X	X	X
2	6	X	X	X	O	X
3	6	X	X	X	X	X
4	8	X	X	X	X	X
5	8	O	X	X	X	X
6	6	O	X	X	X	X
7	3	O	O	X	X	O
8	6	X	X	X	X	O
9	8	X	X	X	X	X
10	5	X	O	O	X	X
11	5	X	X	X	X	X
12	7	X	X	X	X	X
13	4	O	X	X	O	X
14	4	X	X	X	O	X
15	9	X	X	X	X	X
16	7	X	X	X	X	X
17	7	X	X	X	X	X
18	7	X	X	X	X	X
19	7	X	X	X	X	X
20	6	O	X	X	X	O
21	8	X	X	X	X	X
22	6	X	X	X	X	X
23	7	X	X	X	X	X
24	9	X	X	X	X	X
TOTAL		19	22	23	21	21
Percentage		79	92	96	88	88

Mean number of O Levels = 6.5

Sd = 1.5

Table 8.13 cont.

(b) GCE O Level Passes of LDC Teachers

Note: (X indicates a pass and O indicates that the teacher does not have a pass in this subject)

Teacher	Number of Passes	Phys.	Chem.	Biol.	Maths.	Eng.
1	7	X	X	X	X	X
2	5	X	O	X	X	X
3	4	O	O	X	O	X
4	6	O	O	X	O	X
5	5	O	O	X	X	X
6	8	O	O	X	X	X
7	6	O	X	X	O	X
8	4	O	O	X	O	X
9	8	X	X	X	X	X
10	7	X	X	X	O	X
11	5	X	O	X	X	X
12	6	O	O	X	X	O
13	5	O	X	X	O	X
14	6	O	X	X	X	X
15	8	O	O	X	O	X
16	8	O	X	X	X	X
17	8	O	X	X	X	X
18	6	O	O	X	X	X
19	5	O	O	X	O	X
TOTAL		5	8	19	11	18
Percentage		26	42	100	58	95

Mean Number of Passes = 6.2

Sd = 1.4

Comparison of ESP and LDC Teachers' O Level Qualifications

Number of O Level t = less than one

Number of physics passes *Chi-square = 9.9 significant at 1% level

Number of chemistry passes *Chi-square = 10.1 significant at 1% level

Number of mathematics passes *Chi-square = 3.5 not significant at 5% level

* Yates correction applied

Table 8.14

(a) Ages of ESP and LDC Teachers

	Not yet 21	21 but not yet 23	23 but not yet 25	25+
ESP	1	7	7	9
LDC	3	9	4	3

Comparison of ESP and LDC teachers' ages

Chi-square = 3.75 for 3df

(not significant at 5%)

(b) Sex of ESP and LDC Teachers

(percentages in brackets)

	Male	Female
ESP	14 (58)	10 (42)
LDC	9 (47)	10 (53)

Comparison of sex of ESP and LDC teachers

Chi-square = 0.5 1df

(not significant at 5%)

Table 8.15

Head Teachers' Comments on ESP and LDC Teachers Teaching in Same School

(a) Class Control

School	ESP	LDC
a	good	good
b	cool - in control	weak
c	always in control	don't know
d	good	poor
e	good	good
f	affected by personality	don't know

(b) Preparation of Work

School	ESP	LDC
a	good	good
b	thorough	thoroughness not evident
c	very careful	don't know
d	prepares	doesn't prepare properly
e	prepares	prepares
f	needs more	seems to, but needs more seriousness

Table 8.15 continued

(c) Attitude to Teaching Higher Forms

School	ESP	LDC
a	Teaches four O level classes	No O level classes
b	Teaches fourth form willingly	Teaches fourth form but shies away from it
c	Teaches upper forms willingly	Teaches upper forms and willing to do so
d	Willing to	Lacks confidence - was asked but refused to
e	Willing to but doesn't	Willing to but doesn't
f	Enjoys teaching upper forms but content shaky	Knows what he's about Don't think he's hesitant

Table 8.16

Pupils' Reports on ESP and LDC Teachers in Six Schools

(a) Lilian Dewar Teachers

(% figures in brackets)

School	Number in Form	Favourable	Neutral	Unfavourable	Good Teacher	Kind	Experiments	Demonstrations	Notes	Total Practical (experiments and demonstrations)
a	20	15 (25)	5 (25)	0 (0)	2 (10)	4 (20)	2 (10)	5 (25	5 (25)	7 (35)
b	7	6 (86)	0 (0)	1 (14)	2 (29)	4 (57)	1 (14)	1 (14)	0 (0)	2 (29)
c	37	33 (89)	2 (5)	2 (5)	22 (60)	16 (43)	5 (14)	14 (38)	2 (5)	19 (51)
d	28	28 (100)	0 (0)	0 (0)	10 (36)	15 (54)	0 (0)	4 (14)	1 (4)	4 (14)
e	28	19 (68)	4 (14)	5 (18)	8 (29)	2 (7)	0 (0)	3 (11)	2 (7)	3 (11)
f	36	33 (92)	3 (8)	0 (0)	11 (31)	10 (28)	10 (28)	0 (0)	2 (6)	10 (28)
Totals	156	134 (86)	14 (9)	8 (5)	55(35)	51 (33)	18 (12)	27 (17)	12 (8)	45 (29)
Sd		11.7	9.6	8	16	19.8	10.5	13	8.8	14.6

Table 8.16 continued

Pupils' Reports on ESP and LDC Teachers in Six Schools

(b) ESP Teachers

School	Number in Form	Favourable	Neutral	Unfavourable	Good Teacher	Kind	Experiments	Demonstrations	Notes	Total Practical (experiments and demonstrations)
a	24	15 (63	4 (17)	5 (21)	5 (21)	1 (4)	1 (4)	8 (33)	8 (33)	9 (38)
b	7	6 (86)	0 (0)	1 (14)	2 (28)	4 (57)	1 (14)	3 (43)	0 (0)	4 (57)
c	33	29 (88)	3 (9)	1 (3)	15 (46)	10 (30)	12 (36)	7 (21)	3 (9)	19 (58)
d	39	38 (97)	1 (3)	0 (0)	16 (41)	9 (23)	3 (8)	3 (8)	1 (3)	6 (15)
e	28	14 (50)	9 (32)	5 (18)	7 (25)	2 (7)	11 (38)	2 (7)	2 (7)	13 (46)
f	43	37 (86)	5 (12)	1 (2)	23 (54)	3 (7)	1 (2)	7 (16)	0 (0)	8 (18)
Totals	174	139 (8)	22 (13)	13 (8)	68 (39)	24 (17)	29 (17)	30 (17)	14 (8)	59 (34)
Sd		17.9	11.5	11.5	13.1	20.3	16.3	14.3	12.5	18.5

TABLE 9.1

Results of ESP Criterion Sampling Test

Teacher	Skill Number 1	2	3	4	5	6	Total
1	64	85	93	52	50	50	394
2	43	88	53	76	50	100	410
3	58	88	100	52	50	100	448
4	56	85	67	80	25	100	413
5	63	87	100	60	100	100	510
6	63	83	87	68	50	100	451
7	70	96	100	76	100	100	542
8	73	78	100	80	100	50	481
9	43	80	93	76	100	100	492
10	55	79	100	76	100	100	510
11	43	61	90	68	50	25	337
12	49	76	-	-	-	-	-
13	64	84	93	72	50	100	463
14	61	95	97	72	100	100	525
15	55	90	100	80	50	100	475
16	60	80	97	52	25	100	414
17	51	66	100	76	100	100	493
Minimal Competence	55	53	50	48	50	50	306
High Competence	85	85	93	76	75	100	514

TABLE 9.3 Headteachers' Comments on ESP Teachers' Teaching Performance

Teacher's Rank on CSA test	Preparation of work	Content confidence	Attitude to teaching higher forms	Class control
1	prepares well in advance	confident	prefers higher forms	good
2	good	confident to 4th form	teaches 5th form	good
3	prepares well	very confident	teaches only higher	good
4	good	very confident	happy to	good
5	fair	good	would if asked	some concern *
6	very conscientious	very confident	teaches mostly higher	good
7	good	knows his subject	likes to	good
8	prepares well	good up to 4th form	slight reluctance	good
9	very good	confident	happy with them	very good
10	not consistent *	knows content	willing	needs improvement *
11	good	good	good	good
12	O.K.	confident	happy teaching them	a little problem *
13	prepares well	good up to 4th	hestitant about 5 th *	very good
14	needs more *	good up to 5th	enjoys higher forms	problem *
15	thorough	has increased	a little afraid	a little problem *

Table 9.5

CSA and Head Teachers' Assessments of ESP Teachers' Subject Knowledge

CSA Score (Skill 1 + 2)	Teaches GCE Class
166	yes
156	yes
151	yes
150	yes
149	yes
148	yes
146	yes
146	yes
141	yes
134	Yes
131	Yes
125	no
123	no
117	no
104	no

r_{pbi}= 0.8 p .001

Table 9.6 Pupils' Reports on Teachers who took part in the CSA Test

(Percentages in brackets)

Teacher	No of pupils	favourable	Good teaching	Experiments	Demonstrations	Notes
1	28	14 (50)	7 (25)	11 (39)	2 (7)	2 (7)
2	30	16 (53)	10 (33)	7 (23)	9 (30)	0 (0)
3	36	34 (94)	22 (61)	0 (0)	3 (8)	8 (22)
4	28	19 (68)	8 (29)	1 (4)	6 (21)	0 (0)
5	9	9(100)	7 (78)	1 (11)	0 (0)	0 (0)
6	50	48 (96)	18 (36)	1 (2)	6 (12)	2 (4)
7	29	26 (90)	16 (55)	0 (0)	0 (0)	0 (0)
8	31	29 (94)	15 (48)	2 (6)	1 (3)	0 (0)
9	35	35(100)	16 (46)	0 (0)	2 (6)	3 (9)
10	20	16 (80)	13 (65)	0 (0)	1 (5)	1 (5)
11	32	30 (94)	28 (88)	0 (0)	9 (28)	0 (0)
12	-	-	-	-	-	-
13	31	20 (65)	12 (39)	10 (32)	11(35)	1 (3)
14	25	17 (68)	4 (16)	2 (8)	1 (4)	4 (16)
15	30	27 (90)	22 (73)	1 (3)	3 (10)	4 (13)
16	34	33 (97)	19 (56)	3 (9)	0 (0)	7 (21)

Table 10.2

ESP Teachers' Scores on Different Measures of Performance

Supervisors' Assessments	Science Examination	Self-image	CSA	Pupils' Reports	Heads' Opinions (GCE)
B-	55	323	394	25	yes
B-	49	268	410	33	yes
B-	46	323	448	60	yes
B-	62	333	413	28	yes
C	71	329	510	78	yes
A	56	341	451	36	yes
B+	67	271	542	55	yes
B	66	324	481	48	yes
C	45	-	492	46	no
B	39	324	510	65	yes
B+	50	346	337	88	no
C+	36	200	-	-	no
B	45	315	463	39	yes
B	48	281	525	16	yes
B-	48	337	475	73	-
B-	57	270	414	56	-
C+	49	-	493	-	no
C+	62	279	-	-	-
B	37	272	-	-	-
C+	49	302	-	-	-
C-	58	232	-	-	-
C	50	290	-	-	-
C	72	273	-	-	-
B	47	281	-	-	-
D+	51	287	-	-	-
B+	49	309	-	-	-
D+	44	-	-	-	-
C-	53	-	-	-	-
C+	54	-	-	-	-

Table 10.3 Correlations Between ESP Teacher's Scores on Different Measures of Performance

	Superviser's Assessment	Science Examination	CSA	Self-image	Head's Opinion	Pupils' Reports
Superviser's Assessment	X	.04	.13	.37	.33	.07
Science Examination	.04	X	.09	.31	.42	.05
CSA	.13	.09	X	-.24	.19	-.05
Self-image	.37	.31	-.24	X	.34	.35
Head's Opinion	.33	.42	.19	.34	X	-.39
Pupils' Reports	.07	.05	-.05	.33	-.39	X

ESP Teachers' Replies to Section 4 of STSIS Questionnaire

The ESP has helped me in my teaching quite a lot. I have become a more confident teacher,more assured when I am in front of a class. My teaching method is now different due to the various pedagogical methods I have learnt about. The training programme has taught me to look at science teaching in a different manner altogether - that science teaching is more interesting when children can actually see and do things rather than hear about them.

I have taught other subjects before embarking on the ESP. The education and psycology courses were of great benefit to me. They assisted me to understand my students better and to help them more. The course also helped me to organize group activities better and to deal with more difficult situations. I am in a better position to teach lab skills. I can now use the few equipment available to get over lab skills by using 'station techniques'. The course also assisted me in test construction items as well as students' practical assessment.

I benefited in three (3) main ways from my (ESP) training programme. These are as follows: (i) I am far more confident now when I appear before my class. (ii) My knowledge has been improved in more subject areas. (iii) I have acquired skills in teaching that enable me to get through to my students extremely well.

The Emergency Science Programme has benefited me tremendously in the teaching of science. It made me more aware of pupils' needs. It also guided me in adopting different methods in passing on information to pupils so that they can progress satisfactorily with their studies. Also, the programme has provided me with the knowledge of improvising apparatus when necessary and for students to follow the same pattern. Finally it has also widened my knowledge in certain areas in the field of science.

I have benefited from my training programme in several ways namely:
(1) Increase in knowledge in science,mathematics, geography etc.
(2) Confidence. I have now become a more confident teacher.
(3) Increase in knowledge in carrying out various experiments.

I feel that my training programme has better equipped me to teach science. I am able to have better class control and to see myself as a facilitator when teaching students' interests are stimulated by being actively involved in practicals and discussions. I feel more confident of myself in front the class encouraging students instead of punishing them for petty offences.

Seeing that I am now trained, I feel more confident and equipped when I am teaching a class. I am more capable in handling students and their problems. Class control becomes a very easy task and I am capable of teaching any type of lesson. I feel very happy and a great deal at ease in front of a class. Science being a practical subject I feel more at ease when students discover things for themselves and improvisation is real fun to the students. They enjoy the subject more and as such learning becomes an easy task. As such motivation is simple.

While I feel that the programme has adequately equipped me to teach Integrated Science in forms I - lll and perhaps form lV, I do not feel that the programme has provided me with enough science knowledge for the teaching of specific science subjects in form five. The science content could have been wider and to a higher level, perhaps reaching the A level standard. I also feel that more emphasis could have been placed on practical classroom situations rather than ideal situations. For example, in the areas of improvisation, knowledge is lacking as to how to make maximum use of local resources.

In my opinion the Emergency Science Programme has aided me in many ways to improve as a science teacher. First of all it made me realise that there are more effective methods of teaching science, than the lecture method. Secondly it has increased my knowledge in the subject as well as in the field of child study. I am now able to understand the students I teach as individuals with their own personality and, therefore, have tried to apply the best method of teaching by which the students will be able to participate meaningfully and at the same time learn. Most of all having completed this training I feel more confident and capable of teaching science or any other subject within my scope.

My training programme has enabled me to structure my lessons so that they are suitable to the level of the pupils I teach. It has also enabled me handle my lessons more competently so that the objectives I set are satisfactorily achieved. In the laboratory I am now more at home with the equipments. In cases where equipment are not available I am now able to improvise apparatus,which can be used to attain the same objectives. The programme has made me into a better teacher of science than I was before.

The Emergency Science Programme helped me in a number of ways. Firstly I think it helped me to function more effectively in my lessons. The programme helped me to acquire knowledge of various teaching methods that can be applied. I also acquired better questioning techniques. I think I can plan my lessons more effectively. I also understand my students better. It aided me to teach science in a way that the lessons are relevant to everyday activities, also to have activities for pupils in my lessons.

It assisted me in teaching methods. It assisted me to set objectives clearly and plan activities that are relevant to the objectives. I learnt that assessing my lessons is very important. The programme made me more familiar with science equipments and also my knowledge in some areas of science has improved. The programme made be better able to do more research for the teaching of science.

Prior to my involvement in my training programme I was not acquainted very well with proper methodology and questioning technique. However, with the completion of my training programme I feel more condifent in these areas. All in all I feel more at ease with my students now than ever - even if there are observers present.

After completing the Emergency Science Programme I found my self aware of many things which I had previously not known. I now feel more competent and able in my class for example I have learnt better teaching methods , can be able to set up and assemble more apparatus, prepare a more healthier and pleasant atmosphere in the class room. Encourage interaction between pupils,teachers and even their surroundings. I can now even improvise in using local equipments. As such I think I have to thank the ESP for having gained this knowledge.

I think the ESP programme was very helpful in preparing me in the teaching of science. Frankly prior to my training programme I was unwary of the many strategies that would be employed in teaching science. However,now that I have been exposed to the ESP I find myslef not only geared with the various methods in excuting my lesson plans but also with the confidence required to successfully inculcate learning skills in pupils of science. Now more than ever I realise how necessary it is for teachers to be trained before taking on the responsibility of the job. Besides the confidence which it instils in teachers there is the indirect or perhaps direct contribution which it makes towards building the personality required of teachers in order to win the much needed respect of pupils in and out of school.

Most important, I've been made to realize that science is a "process" of learning which involve actions , rather than the accumulation of facts taken from books; thus I now try (as best I could) to allow mush more pupil-participation and practical work, instead of just facilitating a transfer of notes from text books to pupils note-books.

(1) Science content of course: the academic of the course was of little value, as I feel that a teacher can acquire content easily from a variety of sources. Also the course being of a limited nature, the content selected for presentation seemed to be quite arbitrary and irrelevant (in many cases) to the level of the Integrated Science programme in most schools (3rd form). (2) Teaching techniques and skills : in this aspect ,the course was of a high standard and I benefitted quite a lot. Methods and techniques of preparing and presenting a curriculum were acquired,plus additional skills in teaching and class management. I also gained experience in using new equipment and being exposed to other branches of science. I do believe that the overall course was of a good standard and that I benefitted quite a lot. I can be a better teacher if I follow and use all I have gained.

The training programme has prepared me fairly well to teach science.

The past three and a half years have seen a major advancement in the method in which I teach science. Before I underwent training I taught science on a weekly basis. This caused many set backs; topics were done in the wrong order,improvisation was poor and I found the great problem of altering my experiment to meet my own environmental situation. Now with the Emergency Science Programme completed,I am more confident. I can adjust to meet a given situation and I can plan partially a year ahead which enables the work to take a better sequence. Today I can relate more to my students and feel more at ease to entertain their questions.

It has enabled me to have better skills in handling scientific apparate Also I am in a better position in preparing lessons and understanding children's behaviour. What the programme did not do for me, was it did not prepare me to handle actual teaching situations for example over (practical) crowded classrooms, or dealing with mentally "backward" children.

I gained much from this course in the area of teaching methods. The guided discovery approach is one that I appreciate and apply in the classroom whenever possible depending upon the availability of apparatus. I also gained a lot in the setting of objectives for a lesson. i.e. one must take into account the age,ability level of intelligence of pupils as well as the time factor.

The Emergency Science Programme has indeed helped me to improve my teaching science. However,one problem I experienced was the exposure to working in a lab. The school I work at during my period training was unfortunate because it has no laboratory. Thus the skill taught to myself could not have been properly developed.

For me my training programme was well done only a few delays that caused me to feel neglected. My programme have helped me a great deal and have made me more confident in my job.

The training programme has done a great deal to me. It has made me more confident and satisfied on the job. I have gained a lot of experiences and learnt to (1) prepare better lessons(2)improvise apparatus when necessary and an all round better approach to teaching.

LDC Teachers' Replies to Section 4 of the STSIS Questionnaire

My training programme indeed played a great part in making me so effective confident and successful a science teacher that I feel I am. I have learnt how to apply and adapt my self in a variety in teaching positions to improvise and to use pupils experience as a prerequisite for their learning. Also in keeping with the objectives of science teaching to let pupils apply their knowledge learnt in everyday situations.

My training programme did not prepare me adequately to teach science. This I think was mostly due to the fact that there was a shortage of lectureres in all the science subjects from time to time, especially in the second and third years when ther was no physics lecturer. However with a little work on my own I think I can adequately prepare myself.

(1) My training programme prepared me to teach science in that it was there that I learnt and developed the various skills in science teaching- eg the different ways in which children learn science-ie experimentation, observation etc. (2) My training programme also taught me Psychology which helps me in dealing with the students especially the first formers,I don't have to use the cane,its just a matter of applying some kind of Psychology eg depriving them of something they like quite a lot.

My training programme should have given a more in depth knowledge of Science - Physics, Chemistry and Biology. There should be also special training in audio-visual,apparatus making etc. More tours should be organized to industrial,scientific places. The study of Psychology should have a greaterrole during training as we are exposed and we deal with human behaviour of all sorts. Teaching practice sessions were good as it exposes you during training to the school. Provisions should be made for teachers who want to try out different methods. There is always the fear of making a mess of that particular method and being graded at that particular lesson. Teaching practice should be a sort of trial and error sessons.

The sessions which I feel were most helpful were those spent on teaching practice. Such actual classroom exposure provided the opportunity of experimenting with methods that were relevant to specific behaviours. I have also gained experience in managing adequately in a situation where there is a shortage of materials - an experience I value so much more since I am at the moment faced with the problem and so often I

I have to be resourceful.

Not inconsistent with the general developmental objectives of the policies of Third World Countries, it is felt that the philosophy and method underlying teacher-training for Science Education in Guyana serves well in stimulating critical thinking, a rational approach to scientific and social activity ,motivational techniques,assessment procedures,the creating of appropriate behavioural objectives and so on. At the same time this educational theory juxtaposed with educational practice bringing in its tone persepective the nature of the educational process - a gradual subtle creating of psoitive goal directed behaviour. Also having considered many aspects of the human person a greater understanding of interpersonal and group relationships evolved. The course was good,content well defined and up to date people pleasant.

I am of the opinion that my training programme did not prepare me adequately for the task I am faced with. Coupled with that is the fact that while college and going through the ordeals of teaching practice I was placed in situations where I was made to feel and actually did the things that is expected of an ideal science teacher,but because of the kind of responsibilities that has now been trust upon me I am aware of the fact that I am not the kind of ideal science teacher that I was trained to be. Neverthe less I feel satisfied after having been through the training programme that I have been though,despite the short comings of that programme I am in a position where I can put many of the ideas learnt into practice. Added to that,attitudes and habits that are favourable to a good science teacher that were practiced by the persons who taught me I have adopted and have seen them working like they worked for the persons from whom I learned them.

The training programme at Lilian Dewar College of Education has prepared me to teach Science theoretically but in actual fact when I am faced with the school situation,there are many other things that I would have liked to be included in the programme. Firstly,during the training programme my study on methodology was based on an ideal teacher in ideal conditions,whereas in the real situation it is completely different. Secondly,the practical and laboratory sessions were inadequate to fulfill the requirements of the WISC programme. Thirdly, I was faced with the problem of not having an adequate staff at the college to carry out the training programme.

Training at Lilian Dewar has adequately prepared me for my full time task as an Integrated Science teacher. This can be seen in the following ensuing paragraph. The methodology of science teaching was tremendous. The motto of science methodology was to be an interesting ideal enthusiastic science teacher. The atmosphere at college successfully enabled me to satisfy this motto. The tutors taught by example. Experiences obtained from research and tasks were assist to my training. I feel very competent in teaching science. However,I feel that because of the way children were taught science in the past,they somteimes find it difficult to discover and think for themselves. They should be able to overcome this gradually.

My three years training has greatly improved an awareness of myself, my problems, others and their problems. It has so far enabled me to deal successfully with people and in this sense has made me into a very understanding person. Knowledge of Psychology and Principles of education has greatly enhanced my methods of dealing with behavioural problems. Science methodology has enabled me to present my subject in a very interesting manner. As a matter of fact, it has taught me to be aware of the many things one has to consider when dealing with people and I think I can safely say that this is one of the most important aspects of living. Considering all the things that one has to take into account I am very willing to say that it has made me into a critical teacher and how to pass this on to my students. However,I think that the content that is taught should be increased since one may find himself dealing with not only 1 - 3 forms but with 4th ,5th and maybe even 6 th formers.

Now that I am placed in a secondary school in the rural area to teach science, I can safely say that I am faced with many constraints. My training has prepared me admirably but to implement some of the imparted knowledge is very difficult. To begin with,there is a lack of physical comfort -crowded classroom; poor ventilation;lack of equipment,lack of chemicals noise and the only laboratory is not properly lighted.
I have learnt that a very good atmosphere must be created for effective teaching but because of the foregoing reasons this is not too applicable.

My training programme has equipped me so much that I will say it was a wonderful programme. The skills and techniques that I have learnt and, the vast experience that I have gained and the content I have acquired,has proven itself very vital in my everyday teaching but there are a few things which should and must be rectified. The things I am speaking about is (a) the shortage of educational personnel (b) lack of facilities (c) the attitude of the people in charge of the training programme (d) the limited amount of money students collecting. In my last statement I seem to go contray to your question but this is very vital and detrimental to most of the students attending the college that I have attended.

My training was programmed for me to specialise in Integrated Science in the forms 1, 11 and 111 levels. Instead, I am requested to teach the fourths and fifth in O level Biology. It is not that I am complaining but complementing the College's programme wherely the emphasis is not only in the volume of the content but the "putting over" of that content to the students from forms 1 to V in general. In addition so-called traditional methods of "chalk-and-talk" and full authoritorianism (teacher's) have been discouraged to a great extent through my training programme. Instead, I have taken a more democratic approach like group activities and written reports on lesson, groups of individuals leading or teaching a lesson etc.

The training programme which I underwent at Lilian Dewar College of Education has done a great deal in the light of preparing me for teaching. Due to the periods of practice teaching which I underwent, I became quiet an open minded individual. I began to learn of the difficulties children faced with and to accept them as well as try to help them in every possible way. The writing of notes of lessons has played a major role. In doing this I have learnt many more things of topics which I have taught I knew all about. I am able to make my objectives clear and know whether or not they have been achieved at the end of the lesson because they are their laid out in front of me. The depth of which subject content is done, extra curricular activities though they weren't many and micro-teaching. These are the most important but not all.

It is my opinion that the three-year programme should be shorter. I feel so because the work done in the three years can be done in a shorter time. If,however,the three years continue, then the programme should include more tutoring in Methodology and Teaching Practice (guided). Science teaching demands a great deal of effort from teachers. I feel that in order to teach Integrated Science efficiently in schools we should be guided in Integrated Science and not Chemistry,Biology and Physics. More laboratory preparations should be done in college: this can only be so if the college had proper lab facilities.

My training programme has prepared me in many ways. Firstly ,I learned various methods of teaching science. For instance, the implementation of group work demonstration and individual work. One method which is very important is field study. Secondly,I find that in establishing a need to know is vital in a science lesson. This can be done by using stories,everyday examples and further still film strips,films and over head transparencies can also be used - depending on the availability of these. Having done course in Educational Psychology and Principles of Education I have learned to apply or understand such words as maturation and readiness which help me in the planning of my notes of lesson to the standard necessary. All in all,my programme helped me a great deal.

My training programme has equipped me fully in the teaching of science. I was exposed to as many situations as was necessary. Both theory and practicals were done, not only in science ,but also in the other subject areas. Subjects like Psychology and Education which were included in my programme,helped me a lot in getting through my science lessons. The three teaching practices I went through were very helpful. I was guided along the right track by people who knew what they were doing. N.B. Although the training programme was good the conditions under which I studies were not favourable eg signing of contracts,shortage of test-books and stationery, a poor building, 90% attendance. One tend to think that the above conditions came about because of the Government or party in power was not paying enough attention to education here in Guyana.

The training programme has offered me a wide scope of knowledge (content matter) particulary in Chemistry and Physics. This has helped to develop my self- concept. Teaching practice has brought out forcefully the realities of the classroom situation. Here under expert guidance I Tried to master the art of Teaching Science,using various techniques.

In my opinion,the course was a thorough one, in the sense that it was supposed to gear us to teach first to third form students,but as a result we were geared to teach the higher forms. As a result,I am very proud of this because at the moment, I am teaching Physics in the fourth and fifth forms ,gearing them for GCE O Levels in June 1981.
Personally, I feel that in a few years from now,there wouldn't be anyone going to training college to do science because when you go out in the school, it is something else. Imagine I have to teach 38 out of 40 periods with duties as form master. The the salary is nothing much to talk about can bearly survive on such a salary. I think teachers are really underpaid because teaching is a pretty hard task. The teacher is the moulder of the NATION and thus he should be really paid a reasonable salary. I hope when you come, you look into all these factors because these lead to teacher's frustration as a result a walk off the job.

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Appendix 2

STSIS and SST Questionnaires,

CSA Worksheets, List of Dangers for CSA

Test 1 and Marking Criteria Used.

University of Keele

Keele, Staffordshire, ST5 5BG

Telephone: Newcastle (Staffs) (0782) 621111
Telex: 36113 UNKLIB G

Department of Education

5 th., January 1980

Dear

The UNESCO Institute For Education in Hamburg, Germany is carrying out a major research project into evaluation methods in Education. This project is based upon four case studies of innovations in Education; one each in Indonesia, Nigeria, Sweden and Guyana. The Guyanese study is concerned with evaluating different training programmes for science teachers that exist in Guyana. You have been selected as a representative of the training programme which you followed and we would be most grateful if you would assist us with this study by completing and returning the enclosed questionnaire.

The Chief Education Officer, Mr Lowe, has given permission for the data to be collected. Any information that you provide will be treated in the strictest confidence. In the study we are evaluating the training programmes and not the individual teachers. We are sending questionnaires only to a sample of teachers from each training programme. It is extremely important, therefore, that we receive your completed questionnaire so that we can carry out the evaluation. You responses will be used in UNESCO's multinational project, the results of which will be of importance to many Third World countries.

I will be visiting Guyana in January as part of the study. Please return your questionnaire in the stamped addressed envelope provided AS SOON AS POSSIBLE to me via the UNESCO National Commission Office in Georgetown.

Thanks for your help,

Yours faithfully

Michael Brophy

Science Teacher's Self-Image Scale - STSIS

In this questionnaire you are asked to compare your own teaching with that of an IDEAL science teacher on a number of skills which science educators have suggested are needed by science teachers in Guyana.

Below and on the following pages you will see a list of these skills. We would like you to read the statement describing each skill and then decide, if an IDEAL science teacher was in your school teaching the SAME CLASSES as you do, what mark out of ten do you think that you would give him or her for the way that they would demonstrate that particular skill. After you have rated the IDEAL science teacher then you should think about your own EVERYDAY teaching and decide what mark out of ten you would give yourself for the way you display the SAME skill.

Please do NOT write your name on this questionnaire. If there is an item that you do not understand draw a circle around the entire item, otherwise, please rate yourself and the IDEAL science teacher on EVERY item.

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Section 1

Using the scale of 1 to 10, where 10 is the highest score, draw a circle around the score you would give to the IDEAL science teacher and then draw a circle around the score you would give yourself for the way that you .....

1	show an interest and respect for the pupils as individuals	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
2	ask questions both oral and written, which are clear to the pupils	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
3	gain the pupils' interest and arouse their curiosity by presentation and approach	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
4	encourage pupils to make observations for themselves	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
5	plan individual lessons and series of lessons taking into account the pupils' ages, abilities and the time and facilities available	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10

6	encourage pupils to record what they have observed	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
7	use correctly all the different apparatus and materials needed for the science curriculum being used by his/her classes	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
8	use language that is appropriate to the age and abilities of the pupils	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
9	formulate clear instructions, orally, on the chalkboard and on worksheets and cards	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
10	encourage the pupils to feel free to ask questions and make comments	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
11	use language that is understood by the pupils	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
12	pause after posing a question to allow pupils time to think	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
13	suggest examples of scientific knowledge and skills which are applicable to the social and economic life of the community	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
14	encourage pupils to discuss their results with the teacher	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
15	select content relevant to the objectives	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
16	safely store and maintain such equipment as is needed for the school's science programme	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
17	encourage pupils to relate new concepts to other situations within their experience	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
18	gain the respect of the pupils	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
19	indicate the relevant prerequisite knowledge and skills needed for a lesson and find out if the pupils have these	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
20	select and use relevant materials and examples from the local environment	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
21	sequence the steps in the development of a concept so that it is clear and understandable to the pupils	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
22	make use of improvised apparatus when necessary	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
23	ensure that the pupils understand what they have been asked to do	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
24	show respect for the pupils as individuals	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10

25	adapt a lesson to suit the specific local conditions of a school	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
26	encourage pupils to ask questions	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
27	encourage pupils to bring in materials from the local environment for use in lessons	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
28	ensure that information is correct when presenting it to the class	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
29	encourage pupils to record what they have observed	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
30	avoid demonstrating favouritism	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
31	observe safety precautions for any situation that is likely to arise in his/her teaching	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
32	present material so that it is clear and understandable to the pupils	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
33	plan,organize and use a variety of methods including demonstration,group work and individual investigation	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
34	listen to pupils and demonstrate an interest in their contribution	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
35	set objectives that are realistic and achievable by the pupils in the time and with the facilities available	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10
36	relate new experiences to pupils' previous experience	ideal	1 2 3 4 5 6 7 8 9 10
		self	1 2 3 4 5 6 7 8 9 10

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Section 2

Please underline ONE response for EACH question in Section 2

(1) What is your present age in years ?

not yet 21 | 21 but not yet 23 | 23 but not yet 25 | 25 or over

(2) Male | Female

(3) What training programme did you follow ?

Lilian Dewar College | Emergency Science Programme | Any other programme

(4) What type of school do you teach in at present ?

Junior section Primary school | All Age section Primary school | Community High school | Junior Secondary | Senior High school

(5) Which type of school would you most like to teach in ?

Junior section Primary school	All age section Primary school	Community High school	Junior Secondary	Senior High school

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Section 3

Which, if any, of the qualifications, listed below, did you have BEFORE you started your training programme ?

Please tick EACH qualification that you had.

Fourth Year Full Teacher Certificate

GCE O Level (Pass Grade) in Biology Physics Chemistry Mathematics

English Others .....

GCE A Level (Pass Grade) in Biology Physics Chemistry Mathematics

English Others.....

Any other Science, Maths or teaching qualification BEFORE you started your training programme (please specify).....
.....

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Section 4

Now that you have completed your training programme and are teaching full-time we would like you in this final section of the questionnaire to write a paragraph or so giving your views on how you feel that your training programme prepared you to teach science.

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SKILLS FOR SCIENCE TEACHERS

As part of a study of the Emergency Science Programme being undertaken in collaboration with the UNESCO Institute For Education in Hamburg, I am hoping to identify the COMPETENCIES and the SKILLS that are needed by science teachers in Secondary and Community High Schools in Guyana and I hope you will be willing to help me to identify these by completing this questionnaire.

Below is a list of NINE different competency areas, each of which MAY be important for teaching science in Guyana. I would like to know what your general feelings are on the importance of EACH area. I have not given details, on this page, of the explicit meaning of each statement, because I want to obtain your views on this further on.

Will you first, please rate EACH area INDEPENDENTLY on how important you feel that it is, for teachers teaching science to forms one to three in Secondary and Community High Schools in Guyana, to have reasonable competence in that particular area.
Indicate your rating by marking a tick on the continuous line.

	unimportant 1 2 3 4 5 important
Use of scientific methods	
Discipline and management	
Instruction and communication	
Organization and planning	
Evaluation and questioning	
Making learning relevant to the pupil	
Having rapport with pupils	
Relating learning to pupils' development	
Knowledge of subject matter	

I would next like your help in identifying the specific SKILLS which are needed for a teacher to have reasonable competence in EACH of the nine areas.

On the next nine pages please rate each SKILL on its importance WITHIN the PARTICULAR competency area, using this five point scale.

1	2	3	4	5
completely unnecessary	unnecessary	slightly needed	necessary	very necessary

For example, in order to set up and maintain a good rapport with the pupils, how necessary do YOU feel it is, for a science teacher to be able to give praise and encouragement to the pupils ?
Is it completely unnecessary, unnecessary etc ..... ?
You should choose ONE of the five points on the scale for EACH item.

So will you please rate each of the skills on the following pages according to their importance for the COMPETENCE given on that PARTICULAR page.

If there is any item which is unclear please mark that item with a cross.

Use of scientific methods

The teacher must be able to ;	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Encourage pupils to make observations for themselves	1	2	3	4	5
Guide pupils to make conclusions from their observations	1	2	3	4	5
Encourage pupils to record what they have observed	1	2	3	4	5
Encourage pupils to describe or discuss what they have observed with the teacher	1	2	3	4	5
Encourage pupils to describe or discuss what they have observed with other pupils	1	2	3	4	5
Encourage pupils to design their own experiments	1	2	3	4	5
Encourage pupils to ask questions of the teacher	1	2	3	4	5
Encourage pupils to ask questions of other pupils	1	2	3	4	5
Encourage pupils to discuss their results with the teacher	1	2	3	4	5
Encourage pupils to discuss their results with other pupils	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skill or skills below .....
.....
.....

Management and Discipline

The teacher must be able to ;	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
(Class management)					
Appear calm and confident in front of the class	1	2	3	4	5
Establish and maintain a productive informal atmosphere	1	2	3	4	5
Avoid or overcome disruptions	1	2	3	4	5
Gain the respect of the pupils	1	2	3	4	5
Use praise to encourage pupils to work harder	1	2	3	4	5
Avoid using harsh criticism	1	2	3	4	5
Show respect for the pupils as individuals	1	2	3	4	5
Avoid demonstrating favouritism	1	2	3	4	5
(Laboratory management)					
Safely store and maintain such equipment as is needed for the school's science programmes	1	2	3	4	5
Prepare a list of science equipment and materials needed by the school for a coming academic year	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skill or skills below

.....

.....

Instruction and communication

The teacher must be able to ;	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Present material so that it is clear and understandable to the pupils	1	2	3	4	5
Formulate clear instructions, orally, on the chalkboard and on worksheets and cards	1	2	3	4	5
Pace the lesson to suit the pupils' abilities	1	2	3	4	5
Present tasks so that they are neither too difficult nor too easy for the pupils in the time available	1	2	3	4	5
Sequence the steps in the development of a concept so that it is clear and understandable to the pupils	1	2	3	4	5
Allow sufficient time for the pupils to carry out activities	1	2	3	4	5
Encourage pupils to discuss their observations and deductions	1	2	3	4	5
Use a variety of instructional methods	1	2	3	4	5
Ensure that pupils understand what they have been asked to do	1	2	3	4	5
Bring the lesson to a structured close	1	2	3	4	5
Use a chalkboard and aids where appropriate	1	2	3	4	5
Use a chalkboard and aids so that they can be seen and understood by all the pupils in the class	1	2	3	4	5
Use language that is understood by the pupils	1	2	3	4	5
Use feedback from evaluation to make any necessary changes in the lesson	1	2	3	4	5
Speak clearly and loudly enough for everyone in the class to hear	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skill or skills below

.....

.....

Organization and planning

The teacher must be able to ;	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Plan individual lessons and series of lessons taking into account the pupils' ages, abilities and the time and facilities available	1	2	3	4	5
Set objectives that are realistic and achievable by the pupils in the time and with the facilities available	1	2	3	4	5
State objectives clearly and unambiguously	1	2	3	4	5
Select content relevant to the objectives	1	2	3	4	5
Select instructional methods suitable for the pupils, taking into account the time and facilities available	1	2	3	4	5
Have a business-like organized manner when teaching	1	2	3	4	5
Plan for a variety of activities in each lesson to suit the pupils' attention span	1	2	3	4	5
Plan,organize and use a variety of methods including demonstration,group work and individual investigation	1	2	3	4	5
Plan for, organize and use field trips and outdoor lessons where appropriate	1	2	3	4	5
Organize the distribution, use and collection of materials as well as the cleaning up after experiments	1	2	3	4	5
Set assignments and see that they are marked	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skill or skills below

.....

.....

Evaluation and questioning

The teacher must be able to ;	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Evaluate pupils' verbal,written and manipulative work	1	2	3	4	5
Develop a variety of tests,such as; essay,multiple choice and short answer,appropriate to the level of the pupils and relevant to the objectives of a course	1	2	3	4	5
Ask questions,both oral and written,which vary in format	1	2	3	4	5
Ask questions,both oral and written,which are clear to the pupils	1	2	3	4	5
Ask questions in language appropriate to the pupils' ages and abilities	1	2	3	4	5
Involve as many pupils as possible in answering questions	1	2	3	4	5
Pause after posing a question to allow pupils time to think	1	2	3	4	5
Ask questions which involve understanding and thinking as well as recall	1	2	3	4	5
Rephrase questions when pupils cannot understand them	1	2	3	4	5
Encourage pupils to explain or expand upon their answers	1	2	3	4	5
Challenge pupils with a comprehensive array of questions	1	2	3	4	5
Encourage pupils to ask questions	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in THIS competency area ? If so please describe the skill or skills below

.....

.....

Making learning relevant to the pupil

The teacher must be able to ;	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Relate new experiences to pupils' previous experience	1	2	3	4	5
Adapt a lesson plan to suit the specific local conditions of a school	1	2	3	4	5
Select and use relevant materials and examples from the local environment	1	2	3	4	5
Suggest examples of scientific knowledge and skills which are applicable to the social and economic life of the community	1	2	3	4	5
Incorporate into his/her teaching scientific words and items appearing in the local media	1	2	3	4	5
Relate each classroom science topic to the pupil's everyday life	1	2	3	4	5
Encourage pupils to bring in materials from the local environment for use in the lessons	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skill or skills below

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.....

Rapport

The teacher must be able to ;

	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Give praise and encouragement to the pupils	1	2	3	4	5
Gain the pupils' interest and arouse their curiosity by presentation and approach	1	2	3	4	5
Listen to the pupils and demonstrate an interest in their contribution	1	2	3	4	5
Encourage the pupils to feel free to ask questions and make comments	1	2	3	4	5
Encourage the pupils to feel relaxed and free from tension in the classroom	1	2	3	4	5
Demonstrate enthusiasm in teaching	1	2	3	4	5
Show an interest and respect for the pupils as individuals	1	2	3	4	5
Give help to the pupils when needed	1	2	3	4	5
Adopt a conversational manner when talking to the pupils	1	2	3	4	5
Gain the respect and cooperation of the pupils	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skills or skills below

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.....

Relate to pupils' development

The teacher must be able to ;

	0 = completely unnecessary	1 = unnecessary	2 = slightly needed	3 = necessary	4 = very necessary
Encourage pupils to relate new concepts to other situations within their experience	1	2	3	4	5
Indicate the relevant prerequisite knowledge and skills needed for a lesson and find out if the pupils have these	1	2	3	4	5
Use language that is appropriate to the age and ability of the pupils	1	2	3	4	5
Have the pupils involved in manipulating different materials	1	2	3	4	5
Select content that is neither too difficult nor too easy for the pupils	1	2	3	4	5
Encourage the pupils to use differ[illegible] senses	1	2	3	4	5
Incorporate contemporary learning theories into his / her teaching	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in <u>THIS</u> competency area ? If so please describe the skill or skills below

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.....

Knowledge of subject matter

The teacher must be able to ;

	completely unnecessary	unnecessary	slightly needed	necessary	very necessary
Answer correctly all the questions FOR pupils asked in the science curriculum materials being used by his/her classes (e.g.,pupils' workbooks,texts and teachers' guides)	1	2	3	4	5
Apply correctly those principles and concepts which are relevant to the curriculum being followed	1	2	3	4	5
Answer a pupil's question or obtain the answer from an appropriate source	1	2	3	4	5
Use correctly all the different apparatus and materials needed for the science curriculum being used by his / her classes	1	2	3	4	5
To observe safety precautions for any situation that is likely to arise in his / her science teaching	1	2	3	4	5
Make use of improvised apparatus when necessary	1	2	3	4	5
Ensure that information is correct when presenting it to the class	1	2	3	4	5
Relate each topic in the science curriculum to other topics in science	1	2	3	4	5
Relate each topic in the science curriculum to other subject areas	1	2	3	4	5

Are there any other skills which you feel are essential for a science teacher in THIS competency area ? If so please describe the skill or skills below

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WITHOUT looking back at your answers on Page 1 will you now select from the nine COMPETENCY AREAS the THREE that you feel are most important for science teaching in Guyana, giving the one you feel to be most important first, etc.

The three most important competency areas are,

(1) .....

(2) .....

(3) .....

Now can you select the three COMPETENCY AREAS that you feel to be of least importance of the nine, for science teaching in Guyana, giving the LEAST important first, etc.

The three least important competency areas are,

(1) .....

(2) .....

(3) .....

THANKS for your help.

If you would like to know what the overall responses were, please let me know and I will send a copy to you.

Michael Brophy

TEST 1 — SAFETY IN THE LABORATORY — Teacher No .....

In this test we wish to check if the teachers trained via the Emergency Science Programme are able to observe safety precautions for any situation that is likely to arise in their teaching.

In one of the laboratories we have arranged TWELVE (12) potentially dangerous situations which could arise in your teaching. We want you to identify each of the twelve and to suggest a way in which each danger could be prevented or overcome.

In this test the score awarded for each teacher will depend on the number of dangers that are recognized and also on the suggestions made for dealing with them.

	DANGERS NOTED	HOW THIS COULD BE PREVENTED OR OVERCOME
1	.....	.....
2	.....	.....
3	.....	.....
4	.....	.....
5	.....	.....
6	.....	.....
7	.....	.....
8	.....	.....
9	.....	.....
10	.....	.....
11	.....	.....
12	.....	.....

(If you wish you may write on the back of page)

TEST 2 TEACHER NO ____

IDENTIFYING SCIENCE APPARATUS

In this test we wish to check if teachers trained via ESP are able to use correctly all the different apparatus and materials needed for the science curriculum used by their classes.

(A) In the first part of this test we are asking you to identify a number of items of equipment needed in the WISC and SDSP programmes. On a bench in one of the laboratories you will see thirty-seven (37) items of equipment. Each has been numbered. Below you will see the names of thirty-one (31) of the thirty-seven items on display. We want you to identify these thirty-one by writing alongside the name, the number thar the actual item bears. For example, if you can see a ring magnet on the bench, look at the number on it and then write that number alongside its name on this sheet.

In this test marks will be awarded for each item identified correctly.

(Please try not to move the items, we want everyone to see them clearly).

NAME OF ITEM

ring magnet	atomic models	mounting needle
Bunsen burner	filter papers	teat dropper
measuring cylinder	watch glass	resistence wire
boiling tube	microscope	plotting compass
wire gauze	microscope slide(plain)	converging lens
retort stand	microscope slide(cavity)	pestle and mortar
conical flask	plug key	pulley
round bottom flask	dry cell	protractor
dissecting scalpel	bell jar	optical pins
petri dish	filter/vacuum pump	
filter funnel	asbestos mat	

TEST 2

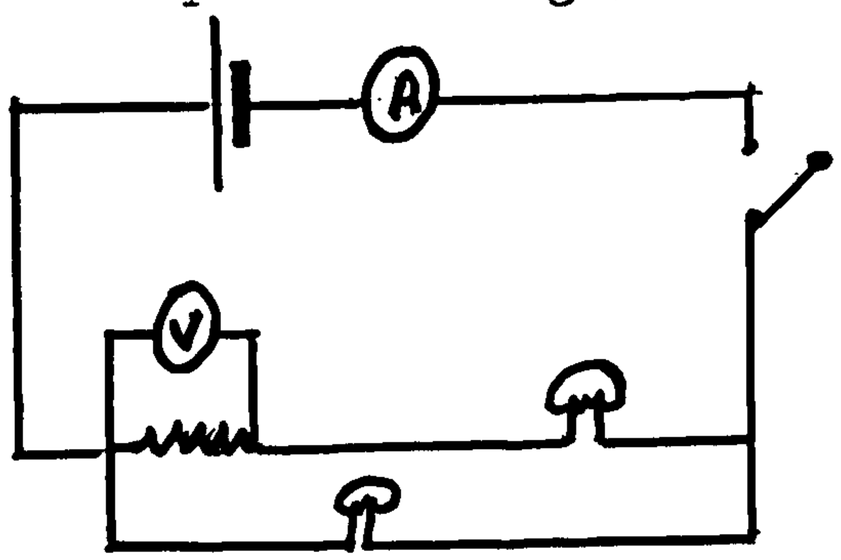
Teacher No _____

ASSEMBLING SCIENCE APPARATUS

(B) In the second part of TEST 2 we are asking you to connect up and assemble three sets of apparatus.

(i) On the bench you will see the following items of electrical apparatus; a plug key, a cell, an ammeter, a voltmeter, a fixed resistance, and two light bulbs.

Use these items to set up the following circuit.....

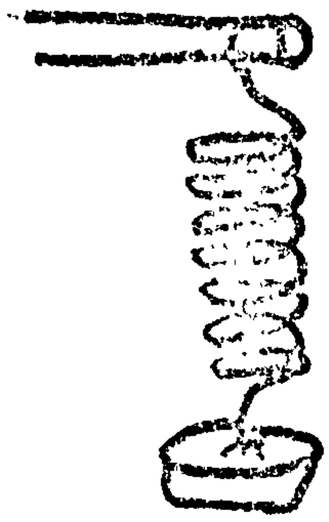


(ii) On the bench you will see the following items of apparatus; a one-holed rubber stopper, a length of glass tubing, a set of cork borers and a boiling tube

We want you to insert the glass tubing through the hole in the rubber stopper and then insert this into the neck of the boiling tube. One example of the finished assembly is on show for you to see.

(iii) On the bench you will see the following items ; a length of wire, a weight and a wooden rod.

We want you to cut off a piece of wire of approximately 450 mm Coil it and then attach it to the weight and the rod as shown in the diagram below. Marks will be awarded only for items which are correctly assembled, so please leave your equipment assembled.



TEST 2 TEACHER NO _____

USING SCIENCE APPARATUS

(C) In this part of TEST 2 we are asking you to use some items of equipment as accurately as you can.

We would like you to:

(1) Use the metre rule to measure the length of the string provided to the nearest millimetre.

(2) Use the stop watch to time the sound on the taperecorder to the nearest half second.

(3) Use the measuring cylinder to measure the volume of the liquid given to the nearest .5 cm^3.

(4) Use the balance to weigh the mass of the stone provided to the nearest gram.

(5) Use the thermometer to measure the temperature of the liquid in the boiling tube to the nearest .5 degree Celius.

(Please tell me when you wish to carry out this activity).

Marks in this test will be awraded for the accuracy of your measurements.

1	The Length of the STRING is	_____	m.m.
2	The SOUND on the tape was	_____	seconds.
3	The VOLUME of the liquid was	_____	cm^3.
4	The MASS of the stone was	_____	g.
5	The TEMPERATURE of the liquid was	_____	^{o} C.

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TEST 3 TEACHER NO _____

SCIENCE TEACHING METHODS

In this test we wish to check if teachers trained via ESP are able to :

(a) guide pupils to make conclusions from their observations,

(b) encourage pupils to record what they have observed,

(c) relate new experiences to pupil's previous experience.

To test these skills we are going to ask you to TEACH a thirty (30) minute lesson to a group of four first form pupils in one section of this laboratory. (The other ESP teachers in this group will be teaching their pupils at the same time). The lesson will be based on the pendulum and at the end of it we want your four pupils to have reached the conclusion that,
"If we change the length of a pendulum we change the time of the swing but if we change the weight of a pendulum we do not change the length of the swing".

You must not tell the pupils this. We want them to draw this conclusion from the observations that they make.

You will be provided with : four sets of weights for pendulum bobs, four retorts with split corks and string, four metre rules and one clock or stop watch (with a second hand). You are also provided with some blank paper you can use for worksheets. We would like you to spend about thirty minutes preparing and writing out your lesson plan. We will be collecting the plan off you after the lesson, so please put your Teacher No on it.

In your written plan we wish you to STRESS how you will demonstrate the three skills which this test is assessing. (See a,b, and c above).

At the end of the lesson we would like you to ask your four pupils to write on the bottom of their worksheets - after their other written work - any conclusions that they have made about the pendulum.

We will be collecting,your lesson plan, the pupils record of their observations and their conclusions. In this test marks will be awarded for ; the way that you plan to demonstrate the three skills, the way that the pupils record their observations and the conclusions that they make.

TEST 4 TEACHER NO _____

ADAPTING A LESSON PLAN TO LOCAL CONDITIONS

In this test we wish to check if teachers trained via ESP can adapt a lesson plan to suit local conditions.

We have made a random selection of ONE lesson from WISC - UNIT 14 Lesson 3, Power : the rate of energy conversion. We want you to adapt this lesson plan to suit a particular local condition (shortage of apparatus). You are provided with a photocopy of the lesson plan given in the WISC Teacher's Guide. This plan, however, involves the use of a block and tackle and a stop watch. We want you to imagine that you are going to teach a third form class which has been following the WISC programme and that you now wish to teach Lesson 3 of Unit 14.
You have neither a block and tackle nor a stop watch (or stop clock), so you must adapt the lesson plan.

Adapt Lesson 3 of Unit 14 so that the pupils will be able to achieve the same objectives without using either a block and tackle or a stop watch (or stop clock). Write out your new lesson plan.

In this Test marks will be awarded for the way that you have adapted the original lesson as demonstrated by the modified lesson plan that you have written out.

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14.3 Power: the rate of energy conversion

Time	*Location*
2 periods	Classroom

Aims

To introduce the time factor into energy conversion, and for pupils to record the number of joules of energy converted per second when they lift loads. To introduce the unit, the watt.

Equipment and Materials

1 strong block and tackle or Weston pulley suspended from an upstairs verandah
1 heavy load (about 400 N) previously weighed on the bathroom scales type balance, and labelled '400 N'. (A load of bricks would be suitable.)
2 metre rules
1 stopclock or watch with seconds hand

Procedure

1 Set the load on the ground, with the pulley attached to it, so pupils can see it. Explain that you have previously weighed the load, and have found that the Earth's pull on it is 400 N.

Discuss how one might measure the *useful* energy converted in lifting a load from the ground to the top floor.

Pupils may respond with 'measure the force used'. It should then be pointed out that all the applied force is not necessarily useful; for instance, some is wasted in overcoming friction. Eventually, pupils will suggest that the Earth's pull on the load be measured. If there is no suitable force measurer available, you can say that it has already been worked out, and you have labelled the load.

Next, elicit the need to measure the distance raised; two metre rules can be used to measure the height of the verandah.

Suggest now that it might be interesting to time the job. After all, workmen often get paid by time, so one could calculate the cost of lifting the load at 60¢ per hour or 1¢ per minute.

Finally, get one pupil to pull up the load, another timing him, two more measuring the height, and one acting as foreman/recorder.

Suppose:

force needed to lift load, F = 400 N
distance raised, d = 3.7 m
time taken, t = 14 s

so useful energy converted, E = $F D$
= 400 N x 3.7 m
= 1480 J

and energy converted per second $= \frac{1480\ \text{J}}{14\ \text{s}}$

$\doteq$ 100 J per s

As about four such loads could be lifted in 1 minute of useful work, the cost of the energy is 1¢ per minute's work, or ¼¢ per load or

$$\frac{\frac{1}{4}}{1500}\ ¢ \text{ per joule.}$$

Deal with the cost calculations lightly, and do not ask pupils to copy those down, as we really want them to concentrate on the energy converted per second.

Ask a second pupil to demonstrate that he would be better value as a workman, time him, and so calculate his rate of converting energy. (No more cost calculations unless pupils are really interested.) Repeat with as many pupils as you like.

2 Explain that there is a special word *used* for the rate at which energy is converted; power. When we talk about power in science and engineering (as distinct from politics) we mean the rate at which energy is converted, that is, how many joules of energy are converted from one form into another per second. In the exercises which have been completed we could say that a certain pupil's power was 100 joules per second; another pupil with a power of 120 joules per second would be more powerful.

3 Because power is a very important quantity, and one that we come across all the time in everyday life, we have a special unit for it, and instead of writing down joules per second, we simply use the word watt.

1 watt = 1 joule per second

The class should record in their notebooks something like this: 'Power is measured in watts, and tells us how many joules of energy are converted from one form to another in 1 second.

1 watt = 1 joule per second

1 kilowatt = 1000 watts = 1000 joules per second'

They can then add a verbal description of the exercise they carried out in lifting the load for a measured time, finishing off the calculation:

'My power was 120 watts' or '. . . . . 's power was 90 watts'

Twelve Dangers Simulated for CSA Test

1 Passageway cluttered with box and stools.

2 Food eaten in the laboratory.

3 Dirty apparatus and equipment left untidly on bench.

4 Reagent bottle left on edge of bench.

5 Mercury bottle left uncorked.

6 Organic solvents stored beside oxidising agents.

7 Carcinogenic chemicals and equipent in classroom.

8 Dissection scapels left on bench with blades exposed and unclean.

9 Wild rat in cage in classroom.

10 Unlabelled chemicals and reagents.

11 Petri dishes with bacteria cultures left open and unsterilized in sink.

12 Spirit lamp burning beside open methylated spirit bottle.

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Marking Scheme Test One Safety Skills

Test 1 Total Score possible 80 For recognition 40 For prevent 40

Score needed to be Highly Competent = 68

Score needed to have minimum competence = 44

Item No	recognition	prevention	
1 (passageway)	3	2	
2 (orange)	3	3	(2 marks if mention need to dispose of orange or cover)
3 (clutter)	2	3	(need to mention clean and store)
4 (edge)@	1	3	
5 (mercury)	4	3	(deduct 1 if don't mention vapour)
6 (solvents)@	3	2	
7 (cancer)	3	3	
8(dissection)	3	4	(clean 2, store 2)
9 (wildrat)	4	4	(if note near electrical or move from children 1 to 3)
10(unlabelled)	4	4	(to get 4th mark need to say dispose off if can't identify)
11 (bacteria)	5	5	
12 (burner)	5	4	
	40	40	

@ Numbers 4 and 6 weighed lightly because of difficulties reported during test 4 moved from edge and 6 not placed closely enough to oxidising agents.

Other Dangers Note by students which can be taken in place of above as dangers

a	Closed back door , kept locked	mark 3
b	Exposed electrical wire (mains)	" 3
c	Topless stool with nail	" 3
d	Loose fit stoppers on reagents	" 3
e	Large containers used by children should be in storeroom	" 3
f	Ammonium thiocynate poisonous should be in storeroom or labelled	" 3

Marking Scheme Test Two Using Apparatus

2A

Identifying Apparatus

Thirty-one items of apparatus to be identified. One mark for each item identified.

High Competence = 29

Minimum Competence= 24

2B

(i) Connecting up electrical apparatus

All terminals tight. Half mark each terminal 14 @ $\frac{1}{2}$ =	7	marks
deduct $\frac{1}{2}$ mark for each loose terminal		
All wire loops clockwise. If ONE or more NOT =	3	
clockwise deduct all three marks		
Ammeter in correct position and polarity		
If either wrong deduct all eight =	8	
Voltmeter in correct position and polarity		
If either wrong deduct all 12 =	12	
Bulbs in parallel and correct position		
If either wrong deduct all 10 =	10	
	40	

High Competence = 35

Minimum competence= 25

2B

(ii) Final Assembly of Rubber Bung and Boiling Tube

Glass tube at correct depth	=	6 marks
if more than 1 cm above or below deduct 4		
if more than 2 cm above or below deduct 6		
Rubber bung tight fit	=	2
Rubber bung correct way up	=	2
Assembly made without breakages	=	10
if breaks 1 glass tube deduct 2		
if breaks 1 boiling tube (or 2 glass) deduct 6		20
if breaks 1 glass + 1 boiling deduct 8		
if breaks 1boiling + 2 glass (or two boiling tubes) deduct 14		

High Competence 16

Minimum competence 8

(iii) Making Spring Coil

Piece of wire left within 20 mm of prescribed length		=	1
Neatness of final assembly		=	13
wastage of wire at attachments	deduct 2		
coils not uniform	deduct 4		
twists in coils	deduct 1		
no coils formed	deduct 3	plus all other deductions	
Functional use			
stays attached to rod if pulled		=	3
Functional Use			
stays attached to weight if pulled		=	3
			20

High Competence 16

Minimum competence 7

2C Accuracy of Use of Apparatus

1 Length of rod

length within 1mm	6	marks
length within 2mm	3	
length outside 3 mm	0	

If answer expressed in cm award two marks for correct length

2 Time of Sound

Time within 0.5 seconds	8	marks
time within 0.75 "	4	
time between 0.75 and 1.0 seconds	2	
time outside 1.0 seconds	0	

3 Volume of a liquid

within 5 cm^3	5	marks
within 7.5 cm^3 (half marks)	2.5	
within 10.0 cm^3	1	
outside 10.0 cm^3	0	

4 Mass of a bottle

within 5 g	6	marks
within 10 g (half marks)	3	
outside 10 g	0	

5 Temperature Reading

within 0.5 degrees	5	marks
within 0.7 degreos (half marks)	2.5	
outside 0.7 "	0	

Bonus marks to be awarded for two measurements or more taken in 1,2 and 4.

Test Two

Part	Total	High Competence	Minimum Competence
A	31	29	24
Bi	40	35	25
ii	20	16	8
iiii	20	16	7
	80	67	40
C	30	25	15

Weightings of A: B: C = 2: 5: 3

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Marking Scheme — Test Three — Science Methods and Relevance

Skill 1 Guiding Pupils to Make conclusions from their observations

In drawing up this marking scheme the panel were presented with a sample of the methods used by the teachers in the test and they then decided what marks would be awarded for each alternative offered.

A If teachers give the pupils detailed instructions (either orally or by worksheet) on how to carry out the investigation, ask them to record their results and then ask them what conclusions they can make from their results

Mark 9

B As for A above but teacher discusses results with pupils before asking for their conclusions

Mark 15

C As for A but teacher discusses results with pupils after asking for their conclusions

Mark 12

D As for A above but teacher dosn't ask for conclusions directly instead asks pupils how each factor affecs the time of the swing

Mark 15

E Teacher tells pupils he wants them to find out how we can increase or decrease the time of a swing. He gives the apparatus and asks the pupils to find out , record their observations. He discusses the results and then asks for conclusions.

Mark 15

If the teacher in his introduction or discussion mentions that he will give the pupils an example of an observation

FROM PUPIL'S WORK SHEETS

Conclusions by Pupils
Relevant conclusions 4
English(style) 1

5

Maximum Score possible 25
High Competence 19
Minimum Competence 12

Skill 2 Encourage pupils to record their observations

In drawing up this marking scheme the panel were presented with a sample of the methods used by the teachers in the test and they then decided what marks would be awarded for each alternative offered.

A If teacher provides pupils with worksheets or gives directions to them to prepare a worksheet which provide them with instructions to follow and in which they have to write down their results at each stage.

Mark 20

B The teacher tells pupils to write down what they have observed after each activity

Mark 10

Pupils' Work sheets

Accuracy of records	=	6
Neatness of record	=	4
		10
Maximum Score Possible	=	30
High Competence	=	28
Minimum Competence	=	15

Skill 3 Relates new experiences to pupil's previous experience

In drawing up this marking scheme the panel were presented with a sample of the methods used by the teachers and they then decided on the scores to be awarded for each.

A If teachers shows the pupils a pendulum, names the different parts and shows the pupils how to 'use' the pendulum. Mark 5

B Teacher asks the pupils to identify the parts of a pendulum Mark 5

C Teacher asks the pupils what a pendulum is or what does the word pendulum mean Mark 10

D Asks pupils if they have ever seen a pendulum before Mark 10

E Show pendulum and asks what is it Mark..... 10

F Tells pupils of everyday examples of the pendulum Mark 20

G Asks pupils for everyday examples of the pendulum Mark 10

H Elicits word pendulum from the pupils and discusses the constructions of a pendulum Mark 10

I Shâw pendulum and ask pupils how can we vary the time of the swing of a pendulum Mark ...10

J Ask pupils if they have ever used anything like 'this' before Mark ...10

If teachers get a score of ten they can gain the extra ten marks if they explain what they will do if the pupils can not answer their questions or explain.

Maximum Possible Mark ... 20

High Competence 15

Minimum Competence 10

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Marki..

Skill Adapt a lesson plan to suit local conditions

For this skill the teacher must show how he or she would get the pupils to achieve the same objective with the help of any alternative activity.

A Gets pupils to run upstairs. Weighs pupils,measures the height of the stairs and times in seconds. (watch or pulse) Mark 20

B Gets pupils to lift known weights through a know height in a measured time Mark 20

C Uses a lever to lift a known wieght in a measured time Mark 20

D Uses a spool as a pulley to lift known weight through a knowm height. (if pulley not mounted deduct 15) Mark 20

E Rope passed over a beam to lift a known weight to a measured height in a measured time Mark 17

F Teacher talks about energy conversion,uses a pulley and gets pupils to work problems Mark 5

Maximum Possible Mark = 20
High Competence = 20
Minimum Competence = 10

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Appendix 3

Report to The UNESCO Institute of Education, and Papers Produced with Dr. B. Dudley.

Papers

Evaluation of distance teaching : a Criterion Sampling Approach. In Percival, F and Ellington, H (Editors) Aspects of Educational Technology vol xv. Distance Learning and Evaluation. Kogan Page pp 159-164 (1981)

Patterns of distance teaching in teacher education. Journal of Education for Teaching.(In Press).

Distance-teaching schemes for training small numbers of teachers. About Distance Education No 10 pp 9-10 (1980)

Unesco Institute for Education
Feldbrunnenstrasse 58
2000 Hamburg 13
Federal Republic of Germany

Project 4.21
September 1981
Document 3

FINAL VERSION

9/30/81

A TEST OF THE CRITERION SAMPLING APPROACH TO EVALUATING DISTANCE TEACHING IN GUYANA

by

Michael Brophy
University of Keele
England

This document has been prepared for the review meeting to be held from 28 September - 2 October 1981 in connection with the project on the evaluation of learning in non-formal educational settings

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Introduction

The traditional view of education was that it took place in school or college; something which was 'handled' by professional 'educationalists'. During the past decade, however, a new perspective had been developing, one which rejects the notion of education being the exclusive domain of formal learning institutions but sees it as including all forms of learning wherever they occur, whether it be in formalized institutions of learning (formal education), in out-of-school institutions such as skill learning programmes (nonformal education), or in everyday life experiences (informal education) (Dave 1973). From this perspective education is looked on not merely as a preparation for life but as an integral part of life itself, a lifelong process, stressing individual and collective fulfillment through continuing personal growth (Skager and Dave 1977).

In its 1972 report the International Commission on the Development of Education (UNESCO 1972) referred to this idea of education being a lifelong process and recommended that it should be the "master concept" for educational policies in the years to come both for developed and developing countries. Lifelong education, as yet, is neither an integrated theory nor an educational philosophy but rather a way of conceptualizing and communicating "worldwide trends towards the enhancement and variegation of education's role in society" (Skager 1978).

Since 1972, the UNESCO Institute For Education (UIE) in Hamburg has been concentrating its efforts towards trying to clarify the idea of lifelong education (Hawes 1975). It has produced a series of monographs and books and promoted a number of studies on the subject (UIE 1978 a).
From the perspective of lifelong education each method of learning, whether it be formal, nonformal or informal, is a legitimate way of gaining knowledge, skills, attitudes and values. It was felt, however, that,

> "If these alternative forms of education are to be legitimized by the general public as well as by those who allocate educational resources and opportunities, evaluations of them must provide evidence that they lead to the same outcomes as do the formal educational institutions (UIE 1978 b)

UIE was interested, therefore, in providing a means by which nonformal educational projects (NFEPs) could be legitimized. It sought to develop

a "generalizable scheme" (ibid) for the recognition of the knowledge and skills etc obtained through NFEP s. Accordingly, in 1978, the project "Evaluation of Learning in Nonformal Educational Settings" was launched by the Institute. Based on 3 case studies the project seeks to develop and try out a particular methodological approach (namely = Criterion Sampling Approach) for evaluating student achievement in NFEPs. If this approach proves to be successful UIE suggest that,

> "An initial step will have been taken in providing a means for legitimizing nonformal educational programmes" (ibid).

The project involves 3 case study teams each assessing the feasibility and applicability of using a Criterion Sampling Approach for evaluating a particular NFEP. In selecting the NFEPs to serve as case studies, UIE were guided by a number of criteria. For example, the NFEPs to be used were to have had some "identifiable impact" upon the society in which they were based, they must have met with social pressures and have survived them, they must have an identifible target population and have general aims to guide them (ibid). One of the NFEP s selected by UIE was the Emergency Science Programme of Guyana.

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Guyana

Guyana is an independent socialist republic on the North-East coast of South America. It lies between Venezuela (to the north and west), Brazil (to the south) and Surinam (to the east). Formerly a British colony and known as British Guiana, it was during the past three hundred years, also colonized by the Dutch and the French. The influence of all three former administrations is still apparent and reflected in many of the placenames. The Capital, Georgetown, is named after a former English monarch, the second city, New Amsterdam, after a well known Dutch city and many towns and villages bear French names, for example, La Bonne Intention and Pleasance.

The countryside itself is thought to be the site of El Dorado, the famous lost city of gold and some gold and diamond mining does take place in the interior. The vast majority of the land mass, however, is underdeveloped and over 90 % of the population live along a narrow coastal strip of cultivated land, The rest of the territory is made up of mountainous forest and savannah through which run many rivers. These contain rapids and waterfalls and are extremely difficult to navigate. Away from the coastal region transportation is extremely difficult.

There are three main ethnic groups in the population of three-quarters of a million, namely, Negros, brought as slaves from West Africa to work in the sugar fields and now making up approximately one-third of the population, East Indians,brought into the country as indentured labourers to replace the former slaves after the emancipation of slavery, now make up over fifty per cent of the population, about five percent of the people are of Amerindian descent and live mainly in small communities in the interior savannah and forest regions. Large numbers of Chinese and Portugese were also brought in as indentured labourers in the 19 th century but their descendents now make up less than two percent of the population as a whole. The remaining roughly 10% are of 'mixed race'.

Economy

Like that of many third world countries, Guyana's economy depends upon the production of primary commodities via mining and agriculture. The three key sources of wealth for the country lie in bauxite, sugar and rice. The performance of the three has been disappointing during the past decade. In a 1979 report for the Second World Bank Project in Guyana, Anderson (1979)

noted that

> "The long run performance of the agricultural section in particular is most distrubing with both 'sugar' and'rice' showing virtually zero growth in real terms". (p 35)

Anderson also reports that there was "cause for concern" over the contraction of the mining industry, noting that whereas over the 1960 - 70 period it had grown at the rate of 8 % p.a., over the 1970 - 75 period it had contracted at just over 2 % p.a. The relative decline in these vital sectors of the economy along with the unprecidented rise in energy prices during the 1970's has placed considerable strain on the country. The Newspaper Caribbean Contact (1981) report the unemployment rate to be between 35 and 38 % of the national labour force and the national debt to be approaching one billion US dollars.

Whatever the overall performance of the economy the decline in the relative importance of sugar and rice has doubtlessly exacerabated the political and racial tensions which exist in Guyana. The People's National Congress (PNC) party of President Burnham draws its support mainly from the urban areas whereas the opposition People's Progressive Party (PPP) of Dr Jagan draws its support largely from rural areas. The East Indian section of the community lives predominantly in the rural areas and traditionally works in the sugar and rice growing 'industries'.

Education in Guyana

Education in Guyana was modelled on the British system as it was in many former British colonies. Primary schools were built to accomodate all children up to the age of eleven. A small minority then proceeded to 'grammar' schools, while the majority remained in the 'all-age' classes of the primary schools. Up to 1976 many primary and secondary schools were independent, fee-paying institutions controlled mainly by religious bodies such as the christian churches. However, in September 1976 all schools were 'taken over' by the government and since then the Ministry of Education has been striving to implement the principle that,

> "Every citizen will have the right to free education nursery to university as well as at non-formal places where opportunities are provided for education and training." (PNC 1978)

Both government and opposition parties are socialist oriented and look upon education as being 'pivotal' for success in the transition to socialism and hence upon the curriculum as,

> "a means of promoting national development, as a means of innovation and transformation, as a means of promoting competencies to meet the changing needs of society." (p28)
>
> (Chandisingh 1979)

Positive efforts have been made by the Ministry of Education to implement the government's socialist and egalitarian policies. There are no school or university fees. Text books are provided free to pupils and soon all pupils are to be provided with free school uniforms. However, the economic situation has considerably hindered the Ministry's efforts. In the schools there are severe shortages of materials and equipment, especially for science and technical subjects. (Brophy and Dalgety 1981, Farley 1980). There is also a shortage of trained teachers, again most especially for the science and technical subjects since people with qualifications in these subjects can obtain higher salaries either in local industry or overseas. In his survey Anderson (1979) reported that in Guyana,

> ".....the impact of emigration on the dilution of overall labour force quality was found to be a significant barrier to raising productivity".

One major development within the education system has been to launch, in the mid-seventies, the Community High School (CHS) Programme. This was...

> "designed to cater for the development of the potential existing in all those children who at the age of 11 + years were not allocated to any of the traditional secondary schools which provide primarily an academic programme for 'white collar' workers".
>
> (Mingo 1977)

Community High schools bear some relationship to the secondary modern schools developed in England in the 1950's though the programme has also been heavily influenced by more recent curriculum development in Tanzania (Hinzen and Hundsdorfer 1979). Their primary purpose is to launch their pupils on a programme of continuing or lifelong education. The knowledge and skills taught in these schools are those which are relevant to the pupils' future needs in their community. The programme aims to provide young people with organizing skills for employment and self-employment in accordance with their abilities and interests and the observed needs of the particular community. The major thrust of the CHS Programme, therefore, is towards the acquistion of the relevant life skills needed to live and work in a Guyanese community.

In common with all other programmes of the Ministry of Education, and in spite of its obvious significance for the government's declared aims, the CHS programme has been affected by shortages of materials and personnel. The programme is seeking to provide secondary education for approximately seventy percent of the children in the eleven to fifteen age group. Until 1976 these children had received only primary education. The provision of secondary education will require a vast amount of expenditure. Buildings must be converted or constructed, materials and equipment purchased and large numbers of specialist teachers trained. As part of the emphasis on agriculture and technology a major component of the CHS programme is the study of science. Unfortunately, even before the first CHS school was opened (1975) there was already a severe shortage of science teachers in Guyana.

Science Education in Guyana

There has been a shortage of science teachers in Guyana throughout the past decade. In a position paper presented to the Science Education Committee in 1973, the Science Teachers' Association (STAG) reported that this shortage

> "Militates strongly against any significant overall improvement in our school science teaching". (STAG 1973)

Millar (1976) has referred to the shortage as being the "bottleneck" to rapid industrialization. Surveys carried out in 1974, 1977 and 1978 all found that a high percentage (60 - 84 %) of teachers teaching science in the secondary schools were untrained.

Table 1 Qualifications of Science Teachers in Guyana 1974, 77, 78.

	1974	1977	1978
No of schools	40	50	53
Trained university graduates	21	20	21
Untrained university graduates	32	77	50
Trained non-graduates	40	25	33
Untrained, with A level GCE	58	71	38
Untrained, with O level GCE	36	91	138
Total	187	284	280
Percentage untrained	67	84	81
Percentage A&O level untrained	50	87	63

(Brophy and Dalgety 1980)

The 1970's had been a period of intensive curriculum development in science. In 1976 the West Indian Science Curriculum (WISC) had been introduced into the secondary schools and the Secondary Departments' Science Programme (SDSP) into the community high schools. In 1977 a pilot study of the Caribbean Examinations Council (CXC) Integrated Science Project was launched in a few schools. The majority of schools, however, were short of the materials and equipment needed to teach these curricula and depended upon untrained teachers, frequently school leavers waiting to enter college or university. As might be expected, therefore, frequent difficulties were encountered in implementing these new science curricula (Brophy 1980, Brophy and Dalgety 1981, and Farley 1980).

Coupled with the introduction of these new curricula a number of events occurred which both highlighted the urgent need to launch a programme to help alleviate the shortage of science teachers and also provided the opportunity for this to be done.

1. Reports from UNESCO and Commonwealth Secretariat consultants were published showing that there were severe shortages of scientific and technological personnel generally in Guyana. Ponnamperuma(1975), a consultant from the Commonwealth Fund for Technical Co-operation, advised that,

   "Science at school level provides the input to higher education and training institutions and hence in fact holds the key to the output of scientific and technological personnel."

   and Whitehead (1976), the UNESCO consultant, warned that,

   "The science and technical output of the educational system will not increase until more teachers with appropriate qualifications are available."

2. With the abolition of private education in September 1976 the Ministry of Education found that, while some of the schools which had been taken over had high standards and good facilities, many had been merely commercial 'profit making' institutions with poor facilities staffed predominantly by unqualified teachers. Science had a very low priority in such schools. In one Georgetown school, for example, the physics laboratory was being used as a bicycle shed, while in a New Amsterdam secondary school the GCE O level Biology class was being taught by an untrained teacher,who, at that time,had not sat O level himself. (In the following June,of the sixteen entrants from this class one person obtained a pass grade in O level Biology - the teacher).

3. Prior to 1976 the Science Unit of the Ministry of Education had been staffed by one full-time officer. In September of that year this was increased to four officers, one of whom was appointed through the U.K. Ministry of Overseas Development specifically to supervise science teacher education.

4. The take over of private education had resulted in additional funds being made available for the improvement of science teaching. Unfortunately, the funds could not be used to purchase equipment from abroad. An in-service teacher training programme was one of the few ways in which such funds could be benefically spent.

By December of 1976 the Science Unit had made a proposal to the Science Education Committee of the Ministry of Education that an emergency programme for training science teachers should be launched as soon as possible. This proposal was accepted by the committee but no decision was made at that time as to what form the new programme should take.

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The Emergency Science Programme

At first the solution to the teacher shortage problem seemed to require simply an increase in the numbers of students being trained at the secondary college of education, but this was impractical. Not enough students were being attracted to the existing training programme to fill places already available. The college was housed in a very old building and did not have adequate laboratory facilities even for its current intake and perhaps most important of all, the college was in the capital while the most severe shortages were in rural areas.

Two main constraints on the proposed new programme, therefore, were, (a) that it should be able to train science teachers where they were needed, that is in situ, in their own urban, rural and interior schools and (b) the teachers must be able to continue teaching while being trained. There are few training strategies which allow for both of these constraints. The two which have been tried successfully elsewhere are;

(a) in-service 'sandwich' programmes, and

(b) in-service distance-teaching programmes.

Sandwich programmes involve students undergoing lengthy periods of training during vacations (generally six to ten weeks) and then teaching normally during school term. Thus the training is 'sandwiched' in between two periods of normal teaching. Often the trainees are then supervised by their lecturers or tutors during the teaching periods of the course. There are a number of disadvantages with sandwich programmes. It is expensive to bring students to a central college or training institution and pay for their upkeep for three, ten week periods. Many teachers are unable to be away from their families for such lengthy periods, particularly if they are mothers with young children or if they supplement their salaries by farming or small holdings, as many male teachers do in Guyana. Sandwich programmes require relatively large numbers of personnel during the lengthy 'vacation' training sessions. For instance, the sandwich programme of Ahmado Bello University in Nigeria employed twenty-seven staff to train forty-five students during their 1973 vacation course (Hawes and Ozigi 1975). The programme proposed for Guyana would depend upon the assistance of personnel from the University of Guyana. However, the Universitie's own B.Ed. programme was conducted during the long vacation and so the university personnel would be able to give only minimal assistance. Taking into account the various problems that would be faced by either a college based or a sandwich programme, the Science Education Committee of the Ministry decided that the proposed Emergency Science Programme (ESP) should adopt a training strategy based on distance teaching methods.

Distance Teaching Structure of ESP

There have been few teacher training programmes in recent years which have relied solely upon written correspondence materials. Those which have have had only limited success and have suffered from high drop out rates (Brophy and Dooley 1981). Leading authorities stress the benefits of incorporating some face-to-face teaching into distance teaching programmes (see Perraton, 1976, Holmberg 1979, and Kinyanjui, 1974). They suggest, for example, that a face-to-face component allows a dialogue to be set up between tutors and students and helps to break down the isolation commonly felt by many correspondence students. Face-to-face tuition is especially important for a programme aiming to train science teachers because it provides them with the necessary laboratory skills and techniques.

In the past, correspondence education has been regarded by many educationalists as the "poor cousin" of institutional education (Elliot 1975). It's rapid expansion in the 1970's has been largely due to it being supplemented by new multi-media teaching techniques. These techniques offer great opportunities for improving the nature of correspondence education. In setting up a distance teaching programme in a developing country, however, there is a danger that inappropriate sophisticated technology will be adopted simply because it has been successful in large scale distance teaching projects in developed countries (Barker 1977) and a further problem is that the skills for designing, producing and maintaining multi-media teaching materials are difficult to find in developing countries (Farnes 1976). If such materials can be produced, however, they can greatly enhance the feasability of a distance teaching programme, providing, for example, motivation and feedback to the students, helping them to pace their work and making the written materials meaningful and realistic (Perraton (1973) and Dallos (1980)).

The Emergency Science Programme (ESP) adopted a multi-media approach. Correspondence materials were specifically written for the programme and were supplemented by face-to-face teaching sessions and by audio-visual media materials. ESP is designed for the many untrained O and A level people who are already teaching science in Guyanese secondary schools and offers its students a three-year in-service programme of teacher training consisting of written correspondence units, audio-visual materials, tutorial sessions, vacation workshops, teaching supervision and workstudy. Upon successful completion of the programme the students are awarded a trained teacher's certificate of the Ministry of Education equivalent to that awarded to successful students from the secondary college of education. ESP includes content knowledge in the sciences, in english, in mathematics and in geography and also educational theory and practice. During their three years of training students receive 1,720 hours of instruction and carry out 2,000 hours of classroom teaching.

Correspondence Materials

Over the three year training period students receive eighteen correspondence units, six each year. Each unit is designed to provide learning materials for six weeks of 'home study' and includes reading material, a written assignment and practical work (which may be carried out at home, or in the teacher's own school or at one of the face-to-face tutorial sessions). Eleven authors were involved in writing these correspondence materials, all of them specialists in their own fields. Detailed information about the units is given in Table 8, Appendix 1

Face-to-face Teaching

The face-to-face teaching component of the programme uses four different approaches, namely; weekly tutorial sessions, vacation workshops, supervised teaching and workstudy.

Tutorial Sessions

When the ESP programme began in 1977 local tutorial centres were set up in the most fully equipped secondary school in each of five regions, (See map on page 16) with an experienced graduate science teacher in charge of each centre. The tutorial sessions last three hours and are held on every Saturday during school terms. At these sessions the students carry out supervised laboratory practicals related to the correspondence materials and use equipment and facilities which may be unavailable in their own schools, they receive face-to-face teaching and individual help as needed including group work and micro-teaching and they use the centres to obtain resource materials such as books, magazines and audio-visual materials.

Vacation Workshops

The three week vacation courses are held in Georgetown and form an integral part of the training programme. At the workshops work is closely related to the correspondence materials but emphasis is placed on practical and group work. Course writers and local tutors are involved in the planning and teaching of the workshops.

Supervised Teaching

Throughout the three year training period regular visits are made by officers of the Ministry of Education to the schools in which trainees are teaching. During such visits the student is observed teaching a lesson in his normal environment and the supervisors, who are all trained and experienced science teachers, advise and guide him on the professional aspects of teaching . During these sessions and during their other visits to the schools, the supervisors also act as field-workers for the programme by disseminating information to the students and headteachers, collecting feedback on the correspondence units and weekly tutorials and by trying to solve any school based problems related to the programme.

Workstudy

A key feature of the science curricula now being implemented in the schools in Guyana is the emphasis placed on the relevance of science to the local environment. Since ESP teachers are being trained in their communities they are expected to develop an understanding of the need for school science to be relevant to that community and of how this relevance can be incorporated into the science curriculum. In an attempt to help the students gain such understanding they are required to undertake a period of 'workstudy' or work experience, in which they are attached for a three-week period, during an August vacation, to a local industrial or medical laboratory. In 1979, for example, students were attached to the Government Analyst Department, the Meteorology Office, hospital and private food company laboratories. This component of the programme has proved to be very popular with the students and all the laboratories involved have commented favourably on the work of the students.

Audio-visual Materials

There is no television service in Guyana and the Course Team felt that such broadcasts would be unrealistically expensive for a programme with an initial intake of forty-two students. Supporting audio-visual and resource materials, therefore, are supplied to the students through the local tutorial centres. At the centres the students have access to small libraries of education and science books, tapes, slides, 16mm films , multi-media packages and a selection of science magazines and journals. The books, tapes, slides and multi-media packages were obtained mainly as gifts from the U.K. Ministry of Overseas Development (now the Overseas Development Association) and the magazines and journals from the local J.F. Kennedy(U.S. Aid) Library. Each centre is supplied with a cassette tape recorder and a number of blank recording tapes for use in micro-teaching and group work. Pre-recorded tapes and slides linked with a number of the units are produced by the Ministry and sent to the centres. The 16mm films are supplied from the Ministry's Audio-visual Unit's library, projectors are also available from the same source.

In the early stages of the programme the feasibility of obtaining some video-recording equipment for use at the local centres was examined but three major problems were encountered, namely;

1. the cost was prohibitive,
2. technicians were not available to run and maintain such equipment, and
3. the national electricity service was in the process of converting electricity transmission from a sixty to a fifty Hertz system.

The Audio-visual Unit of the Ministry does have some video equipment, however, and this has been used at the ESP vacation workshops. For instance recordings were made of students teaching in their schools and these were used for micro-teaching sessions.

CONTENTS

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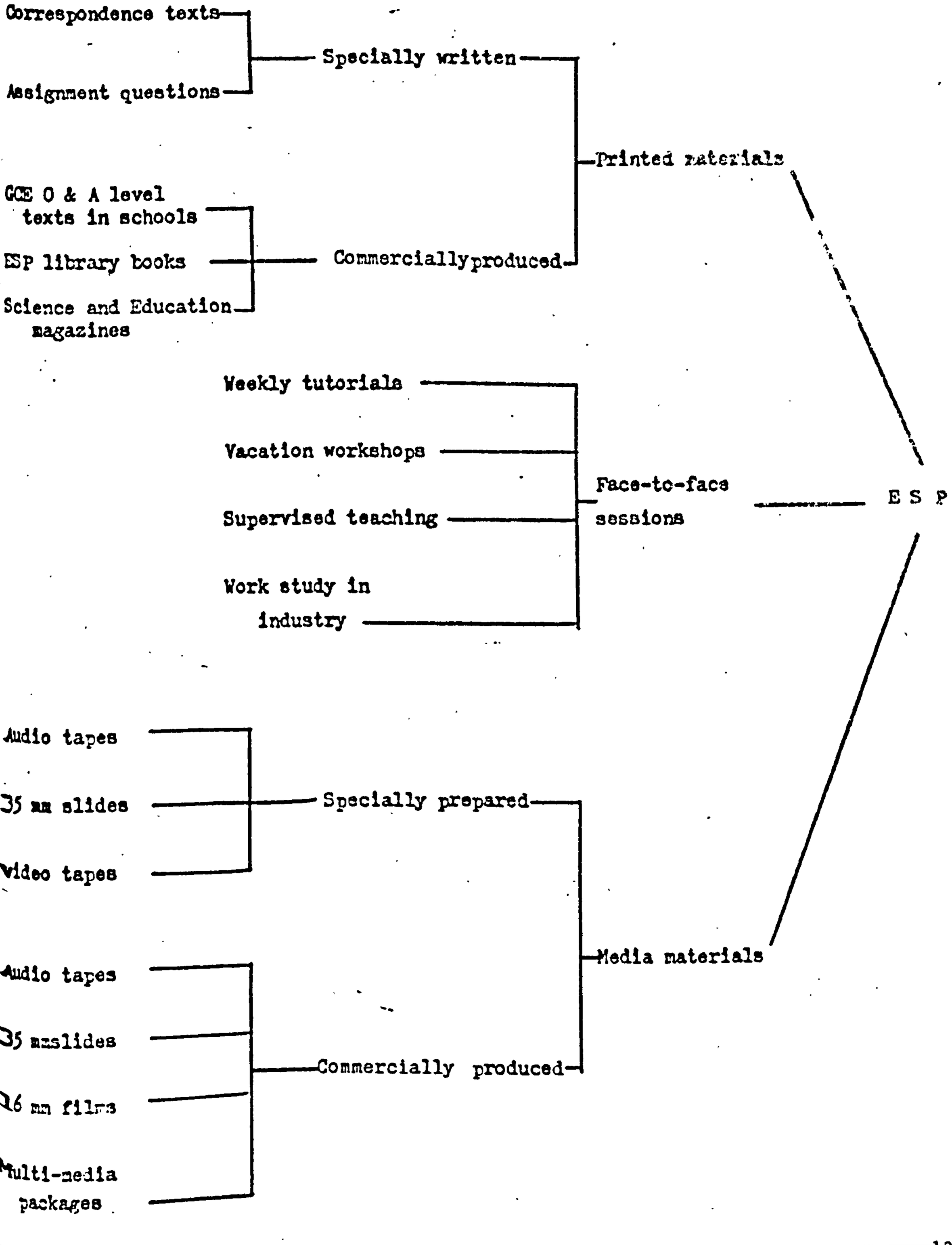
Structure of the Emergency Science Programme (ESP)



Student Population

There have been three intakes of students into the ESP programme, the first of forty-two students in April 1977, the second of eighteen students in September 1978 and twenty in April 1981. With only one exception, the students who have been accepted had at least four passes at GCE O level (67.5 % had six or more passes). Most have passes in English Language (82%), Mathematics (83%) and Biology (86%) and the student's average age on entry is twenty-one. They have each taught for about two and a half years. Many different ethnic, religious and cultural backgrounds are represented, the East Indians being mainly Hindu and Muslim and the Negros and Amerindians Christians. Trainees are recruited from secondary and from community high schools in every region of the country and hence from schools on islands, in cities and towns, in farming areas and the interior. Their incentives for participating include higher status,a certificate,a large pay increase and tenure,if they do not already have it.The map,page 16,has the schools of trainees marked on it.

Aims of ESP

The Emergency Science Programme seeks to increase the number of trained science teachers in Guyanese secondary and community high scools, a development which external consultants, local educators and industrialists have reported as being vital for the future scientific and technological development of the nation. ESP seeks to do this by means of a three-way distance teaching approach aimed at the many O and A level untrained teachers who already teach science in the secondary and community high schools. General aims for the programme were decided on by the Science Education Committee of the Ministry, a body representative of science educationalists at all levels in Guyana with delegates from the University, the colleges of education, and the primary and secondary schools. The Course Team, consisting of Ministry officials, lecturers from the University and practising teachers, decided on the detailed aims. In turn these aims were adopted by the Board of Examiners as a formal part of the overall submission for certification of the programme. ESP, therefore, officially aims to :

1. provide (its) students with sufficient content knowledge in integrated science to enable them to teach effectively the proposed CXC, WISC and CHS science programmes.
2. develop in the students a working knowledge, to A level standards, those areas of chemistry, biology, physics and the earth sciences which will be necessary for an adequate understanding of the proposed CXC, WISC and CHS programmes.
3. expose the students to other fields of study relevant to the teaching of integrated science and the integration of science in the curriculum.

GUYANA

SCALE [redacted].

URBAN & REGIONAL PLANNING PROJECT

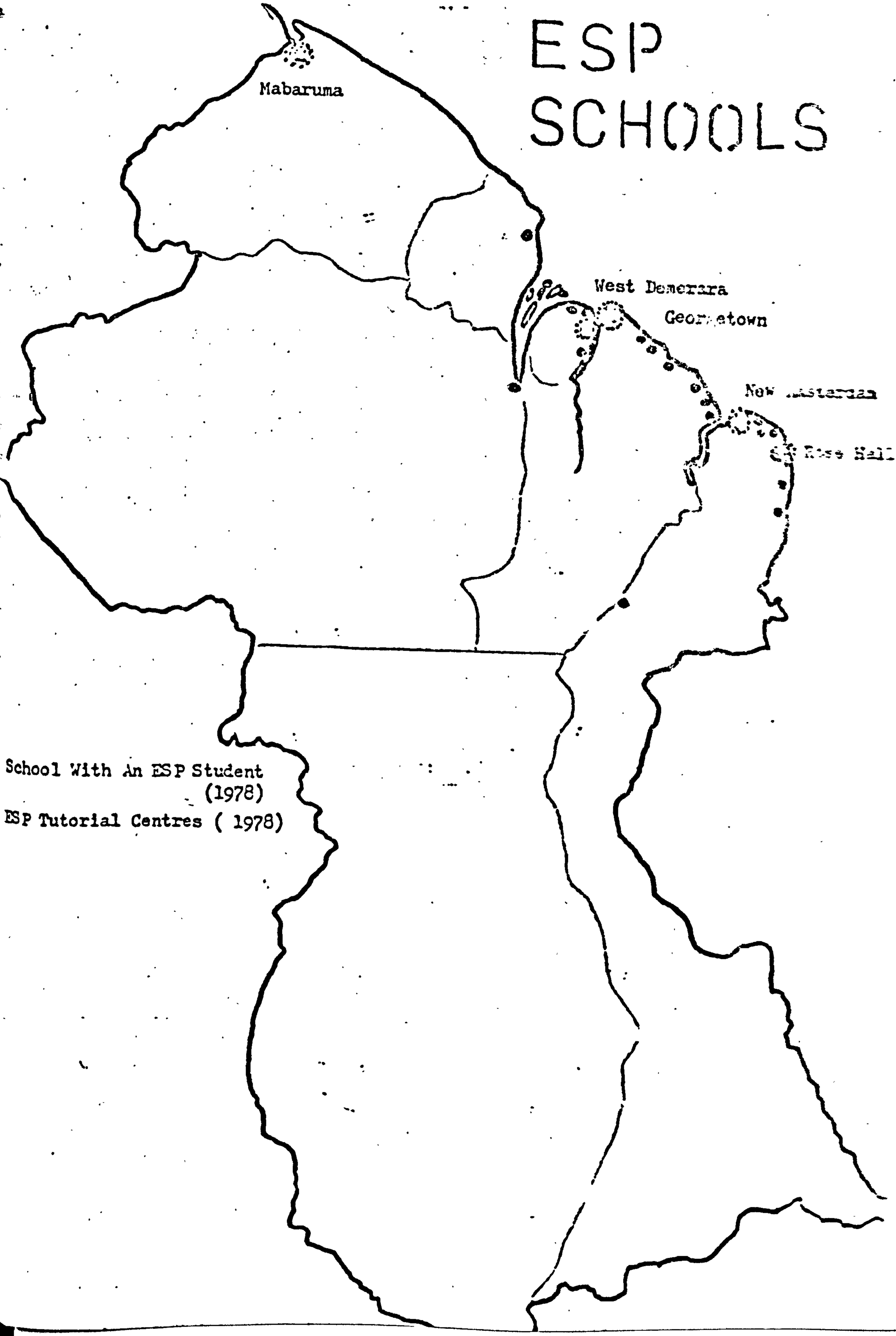
ANNA REGINA
ESSEQUIBO ISLANDS
ZEERUG
STEWARTVILLE
GEORGETOWN
GOLDEN GROVE
COVENT GARDEN
BARTICA
LINDEN
KYAKWAN
ST. IGNATIUS

MAP 4.
EDUCATION

SENIOR SECONDARY SCHOOLS ●

SECONDARY SCHOOLS ◉

ESP SCHOOLS



School With An ESP Student (1978)

ESP Tutorial Centres (1978)

4. provide a course of training in educational theory and practice which will enable the students to fulfill their roles as qualified teachers in secondary and CHS schools, and
5. foster in the students an awareness of the importance and relevance of science and technology to the achievement of the aims of a developing society.

Achievement to Date (1981)

Twenty-nine students successfully completed the ESP programme in 1980 and were awarded the trained teachers certificate by the Board of Examiners of the Ministry of Education. A further twenty to twenty-two ESP students are in training and expected to complete the programme in September 1981. Provided this is so, over 80% of the combined 1977 and 78 intakes will have gained their teacher's certificates and the programme will have increased substantially the number of trained science teachers in Guyana , in deed doubling the numberteaching science in 1977. In the four years since it began !(1977 - 81) the ESP programme will have produced the same number of trained science teachers as did the College of Education in the nine year period (1971 - 79) (Brophy and Dalgety 1980). At the level of number of science teachers trained the programme can be judged a success. In fact the Ministry of Education began preparing for a third intake as soon as the first batch of students had qualified. However, it is important to judge success by the quality of the ESP teachers and not only by the numbers. One measure of quality might be achieved by comparing the teaching performance of the ESP teachers with that of science teachers trained concurrently at the College of Education. There had been an unusually high intake of students into the College science programme in 1977 following the take over of schools the previous year and twenty-six teachers qualified from the programme in 1980. ESP and College groups were both assessed by the same panel of science educators (appointed by the Board of Examiners) and the two groups were awarded equivalent certificates. Comparing the teaching grades awarded to the two groups appears to be an appropriate way of evaluating the performance of the ESP programme. Making this comparison we find that on the ten point grading scale used by the examiners, the college trained teachers were awarded slightly higher grades than the ESP teachers; the average College grade being B compared with the average ESP grade of B- . The highest and lowest grades were awarded to ESP teachers.

Table 2 Pass Grades Awarded to Science Teachers in 1980

Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+
College trained	-	-	3	8	7	3	4	1	-	-
ESP trained	-	1	-	4	6	6	5	3	2	2

Mann Whitney U Test ($Z = 2.54$ $p < .05$)

This comparison is not as straightforward as it might appear, however. The College trained teachers were assessed whilst on a six week teaching practice during which they taught, an average, eleven periods each week. Because they were so widespread geographically and because they normally taught in their schools anyway, the final assessment of the ESP teachers took place over a more extended period of time (three months) during which the ESP teachers taught, on average, twenty-three periods each week. Neither group were told when a Ministry assessor would visit the school to observe a lesson, thus while the college trained teachers needed to prepare for an average of sixty-six teaching periods for the assessment exercise, the ESP teachers were required to prepare for almost three hundred periods.
In such circumstances the teaching grades awarded to the ESP teachers compare favourably with those awarded to the College trained teachers. The comparison with College teachers, however, only provides information on the relative performance of ESP teachers, information on their actual performance was desired. When the UNESCO Institute For Education (UIE) invited us to evaluate ESP, therefore, by assessing the criterion performance of the teachers the invitation was seen as most opportune.

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The CSA Evaluation of ESP

Objectives of the Criterion Sampling Study

The Criterion Sampling Approach (CSA) is one way of evaluating learning in non-formal educational settings and is being evaluated in a special study by the UIE. It arises from the UIE 's desire to know if knowledge acquired through relevant non-formal educational programmes will have the same status as that acquired through the programme of formal learning institutions (UIE 1979). The CSA evaluation of the Emergency Science Programme forms one of four case studies being carried out on behalf of UIE and will contribute to a metaevaluation of CSA, i.e. the evaluation of a methodological approach to evaluating the outcomes of non-formal educational programmes.

One case study is being carried out by the Institute of Education at the University of Ibadan on an in-service primary teacher project and the third is testing the use of CSA in an evaluation of a basic education programme in Indonesia. This, the ~~fourth~~ third case study, is investigating the use of CSA for evaluating ESP, a distance teaching programme for science teachers in Guyana.

Each of the four case study teams have been asked to,

(a) provide a rich description of the procedures used by the team in the CSA evaluation,

(b) document the degree of success obtained in implementing the CSA in a pilot test, and

(c) evaluate critically the applicability and utility of the CSA approach in their own evaluation.

The report is written with these requests in mind.

Criterion Sampling

Unlike most traditional tests which depend upon norm reference measurements, Criterior Sampling uses criterion reference measurements for evaluation purposes. Norm referencing assesses a candidate by comparing his or her performance with that of a large number of other candidates. Criterion referencing assesses a candidate against a fixed, pre-determined, standard. If a candidate achieves a score above the 'fixed' or criterion level he 'passes' irrespective of the number of other candidates who have either 'passed' or 'failed' and irrespective of the supply and demand for people with this 'pass' qualification.

Criterion Sampling, therefore, involves 'quota free' selection (Hambleton and Novick 1973).

Students gain marks in traditional pencil and paper tests by responding to stimuli which they are unlikely to encounter outside the examination hall. Traditional tests also require indirect 'symbolic' responses from the candidates - responses which may have little to do with the individual's actual behaviour. For example, Ghiselli (1966) in a review of fifty years of research on general intelligence tests reported that the correlation between these tests and job proficiency was only + 0.23. In a CSA evaluation an individual is assessed by the score he achieves on a number of situational 'performance' tests; tests which reflect real life situations. A second characteristic of CSA is that it attempts to standardized test conditions. Traditional 'on the job' assessments such as supervisor's ratings are normally based on unstable 'high inference' observation techniques (Rosenshine 1971) and attempt to assess the individual by looking at a'global' or overall performance; a performance which can be affected by many situational and personality variables. CSA controls for many of the variables encountered in real life situations and then tests the candidate's performance on a sample of the tasks he would normally carry out in the everyday situation. This technique, therefore, allows for direct 'low inference' observations to be made of different aspects of the candidate's performance. CSA standardizes test conditions and as Fredenskens (1975) suggests approaches the 'authenticity' of real life. The approach has been described as one,

> "in which the student's performance on standardized samples of tasks for which he has been trained is systematically observed,measured and evaluated". (UIE 1979)

Strategy For CSA Evaluation of ESP

The CSA evaluation of ESP was based on the guidelines produced by UIE (1979) with modifications to suit the particular context of the programme itself. It was decided to carry out the case study in five stages.

(A) <u>Identification of Goal to be Evaluated</u>

One request of UIE was that the case study should measure

> "the extent to which ONE of the nonformal educational programme's most important goals has been achieved" (UIE 1979 b)

The first step in the CSA evaluation of ESP, therefore, was to identify and select this goal.

(b) <u>Determination of Performance Criteria to be used for Evaluating Goal</u>

At the second stage of the evaluation we determine the skills and tasks a candidate should be able to perform if he or she has the required level of competence.

(C) Construction of Criterion Sampling Instruments

Knowing the skills and tasks a candidate should be able to perform we then developed ways of measuring the teacher's performance of them. For CSA purposes tests must be standardized and yet be true to the real life situation. We developed situational tests to measure the candidate's real life performance and which, when taken as a whole would show whether or not the candidate was able to carry out the job for which he was trained.

(D) Testing of Teachers' Criterion Performance

Having developed and piloted the instruments we used them to test the performance of a sample of the ESP teachers and determined if the teachers has in fact achieved the criterion standard needed for their job.

(E) Evaluation of CSA as a Means of Evaluating ESP

Having tested the situational performance of a sample of the ESP teachers the final stage of the case study determined the applicability and utility of the CSA method for eveluating ESP. The results obtained by CSA were compared with those obtained from other evaluation methods and the views of the participants of the ESP programme on the suitability of the CSA evaluation collected and analysed.

Stage A Identifying the Goal

The general aim of the ESP programme is to increase the number of trained science teachers in secondary schools in Guyana and the five goals given in the proposals (see page 14) and accepted officially for certification purposes, all seek to help satisfy the one general aim. Whether it be to provide the students with enough science content (goals 1 and 2), with enough educational theory and practice (goal 4), with enough background in other areas (goal 3 and 5) all five share the same purpose, i.e. to train the students so that they can teach the science curricula used in Guyanese secondary schools, specifically the proposed integrated science programme of CXC and the WISC and SDSP programmes. We decided, therefore, to use the Criterion Sampling Approach to evaluate whether or not this basic aim of ESP had been achieved, namely that those who qualify from the ESP training programme can teach the science programmes used in Guyanese secondary schools satisfactorily. The CXC integrated science programme is in its pilot stages and its course materials are being evaluated and modified. We decided, therefore, to evaluate the ESP teachers' ability to teach WISC and SDSP, the two curricula in use in Guyana at present.

Stage B Performance Criteria for Evaluating Science Teaching

In this second stage of the CSA evaluation we are concerned with identifying what the 'graduate' of the ESP programme should be able to do if the programme has achieved its basic aim and so we address ourselves to the question : what does a science teacher need to be able to do in order to teach WISC and SDSP ?

There has been considerable research in the past fifty to sixty years, into the relationship between the instruction given by teachers and the achievement of their pupils. Barr (1961) reviewed seventy-five doctoral studies on this topic undertaken in one American state alone. Avalos (1980) reviewed the results of 589 studies carried out in third world countries into teacher effectiveness. Husen (1978) reviewed sixty-four such studies in less developed countries and Rosenshine (1971) fifty in developed countries. The results of all this research have been meagre. Pupils of teachers who have received teacher training do appear to learn more than pupils of untrained teachers (Avalos ibid and Husen ibid). The evidence is unclear, however, as to how much training a teacher should have and there is no conclusive evidence to show that teachers with higher academic qualifications make 'better' teachers. (Avalos ibid and Husen ibid).

One major problem in comparing the results of teacher effectiveness studies lies in the fact that different measures of effectiveness have been used in the many different studies. For example, while some researchers have looked at the way different teachers influenced student learning in english,others have looked at learning in science. Some have looked at changes in student attitude, while others have measured teacher effectiveness in terms of supervisor's ratings. What may be an effective stratgey for teaching english is not necessarily effective for teaching science, similarly the style of teaching which helps pupils to make the greatest gains in examinations is not necessarily the style rated as most effective by teaching supervisors. Comparison is made even more difficult by the fact that the studies have been carried out in different countries and in different situations. For example, even if a researcher in Africa and a researcher in the UK used the same measure of teacher effectiveness to assess student achievement in the same subject there will be differences between the two groups being tested in the subject content, the racial and cultural background of the pupils and the facilities and equipment used by the teachers. As Shavelson and Atwood-Russo (1976) have suggested the generizability of results from studies of teacher effectiveness may be extremely limited. Certain teaching behaviours may be effective with certain groups of pupils and yet be ineffective with others. A teacher who happens to be effective in one situation may be ineffective in another.

> "..teacher effectiveness as currently measured may depend on the luck of matching a teacher with a particular group of students".
>
> (ibid)

The result is that in spite of all the research into teacher effectiveness we still have no definative idea of what the characteristics of a good teacher are. Thus Brim (1958) concluded,

> "...although there is a vast body of research on the relation of teacher characteristics to effectiveness in teaching, the reviews of this research.....show no consistent relation between any characteristics, including intelligence, and such teaching effectiveness"

and Heath and Nielson (1974) in their review of performance-based teacher education reported that,

> "Research into the relationship between teacher characteristics and student achievement has been conducted for more than 50 years. A large number of studies of this relationship have been done, but reviewers of this body of research generally conclude that an educationally significant relationship simply has not been demomstrated."

Since the general characteristics of good teachers are not clearly identifiable, there is the problem of how to test the teaching performance of the ESP trained teachers . This was resolved by determining the skills and abilities that were needed specifically by ESP teachers to teach the particular science courses used in Guyanese secondary schools.

In the evaluation of ESP we are not determining if the teachers were 'good' teachers but whether or not the ESP programme was successful in achieving its aim. Thus, we argued that it would be successful if it could be shown to be creating the skills and competences that science educators sought to produce in science teachers. The approach adopted, therefore, was to determine what skills and competences Guyanese science educators wanted to produce in secondary school science teachers. This was determined in a three-stage strategy.

(i) A thorough review of the literature was made to see what competences were generally claimed to be required for teaching science. Reviews were made of those surveys which have collected opinions of science teachers, supervisors, educators, researchers and also of pupils on the characteristics of good teachers. (See appendix 2 for a list of the surveys reviewed). An analysis of these surveys led to nine major competences being identified. These are the nine competences or skill areas which, according to the major surveys carried out, are those thought by educators, teachers and pupils to be most important for science teaching.

The nine competences identified were:

1. Knowledge of subject
2. Rapport with pupils
3. Organization and planning
4. Instruction and communication
5. Discipline and management
6. Questioning and evaluation
7. Use of scientific methods
8. Relate to pupil's development
9. Relate to pupil's environment.

(ii) Using these nine competences a further investigation of the literature was undertaken to see what evidence existed that these competences were important for science teaching. Over 500 studies which have been carried out into the effect of specific skills on teaching performance were reviewed. We then identified the skills which were shown in a number of studies to have been important for effective teaching. (This is not to say that these skills are essential for good teaching on all occasions but that evidence exists to show that in studies where they have been tested they have been positively related to teaching performance). The skills identified were then listed using, wherever possible, wording taken from, or similar to, Guyanese sources, such as the Teacher Assessment Scale (used by the Ministry of Education) and the Science Teacher Rating Scale developed at the University of Guyana (Lalgie 1978). A number of skills which were stressed in the Guyanese sources but which had not been identified in the review of the literature were also included in the list, for example the two skills relating to laboratory management. Altogether we identified [illegible] 84 skills for science teaching.

(iii) These skills were then incorporated into a questionnaire which was designed to establish what skills and competences Guyanese science educators considered to be important for teaching science in secondary schools in Guyana. The questionnaire was first piloted on a group of experienced science educators from developing countries and then on a group of science educators studying for the M.Sc. in Science Education at the University of Keele. The final version was then sent to science educators in Guyana. Each was asked to identify the competences they regarded as being most important for science teaching in Guyana and then to rate each of the skills on their importance within a given

competence. The educators were also asked to suggest any other skills which were not listed in the questionnaire but which they considered to be important for teaching WISC or SDSP. Only one addition was suggested.

The Guyanese science educators concurred with the skills we had identified.

Stage C Construction of Criterion Sampling Instrumentation

The best predictors of a student's behaviour in real life situations are measures of his performance on samples of the situations themselves (McClelland 1973). CSA uses such an approach since it tests the performance of the students on a sample of the criterion behaviours for which they have been trained. Having identified the competences and skills that ESP teachers should have at the end of their training the next step was to obtain a sample of these so that we could test student performance. The sample of skills and competences can be drawn in a number of different ways. Following suggestions made by the CSA Projector Co-ordinator the sampling method chosen for ESP was a modification of that recommended by UIE (Shavelson 1980). Instead of taking a random sample from the universal set of science teacher task/skill combinations it was decided to use a stratified random sampling procedure. The questionnaire responses were used to identify the three competences which the Guyanese educators felt were most important for science teachers to have. These were,

1. Use of scientific methods
2. Knowledge of subject
3. Relate to pupil's environment.

The skills rated by the educators as being important for these three competences were then listed in three separate lists and a random sample of two skills drawn from each list. (See appendix 2) In this way a random sample was obtained of the skills which science educators in Guyana think are most important for teaching WISC and SDSP in Guyanese schools.

The six skills identified were,

1. Observe safety precautions for any situation that is likely to arise in his / her teaching.
2. Use correctly all the different apparatus and materials needed for the science curriculum being used by his / her classes.
3. Guide pupils to make conclusions from their observations.
4. Encourage pupils to record what they have observed.
5. Relate new experience to pupil's previous experience.
6. Adapt a lesson plan to suit the specific local conditions of a school.

Having identified the sample of skills to be tested the next step was to design 'situational' tests to measure the teacher's ability to perform these skills. Both the WISC and the SDSP programmes have prepared and published detailed teacher's guides (Adey 1976, Impey n.d).and an content analysis lesson by lesson was made of these to identify tasks in which these six sample skills were needed.

Test 1 To test the ESP teachers' skill in observing safety precautions.

The Ministry of Education supply to secondary schools a safety booklet which also forms part of the correspondence materials supplied to ESP teachers (Ministry of Education 1978). By means of this booklet twenty potentially dangerous situations, which could arise during the teaching of [illegible], were identified. From these twenty potential dangers, twelve which could be simulated in a static display (i.e. without actors) were selected for use. These includes a spirit burner left burning close to an open bottle of alcohol, a magnet bottle left at the edge of a bench and a bottle of mercury left uncorked (A photograph of some of the potential dangers used in the test is shown on page 27).

The ESP teachers' 'safety skill' could be tested, therefore, by the ability they displayed in recognizing and overcoming these twelve potential dangers, along with five additional distractors.

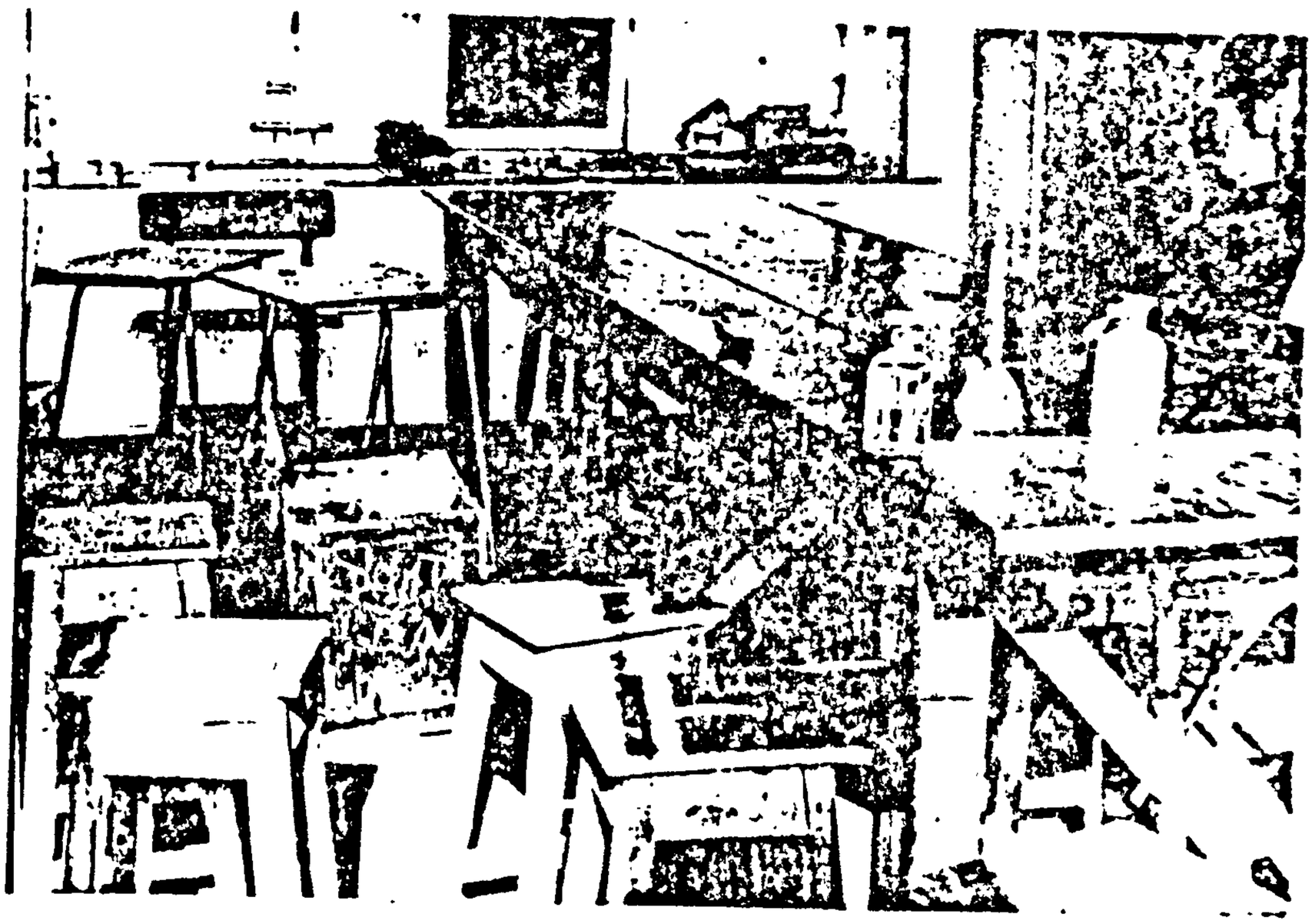
Test 2 To test the ESP teachers' skill in using science apparatus.

To develop a situational test for Skill 2 it was first necessary to determine what a teacher would have to know and do to be able to, "use correctly all the different apparatus and materials needed for the science curriculum being used by his / her classes". After considerable thought and discussion with other science educationalists we decided that in order to use science apparatus and materials correctly a school teacher would first have to identify it, then assemble it into the form required for the pupils to carry out the classroom or laboratory activity and finally he would have to be able to 'manipulate', 'read' or 'use' it to the degree of accuracy required for the activity. Three sub-tests were designed to test the teachers' skill in using apparatus.

In Sub-test 2a, a complete list of the equipment needed to teach WISC and SDSP was prepared. (Equipment required for optional activities was excluded). (See Appendix 3 Test 2a) A random sample of one-third of the items was then selected. Using this sample we would test the teachers' ability to recognize the various items of equipment needed to teach WISC and SDSP.

Sub-test 2b. An analysis of the teacher's guides of WISC and SDSP was done to identify tasks which would require teachers having to 'join togdher' or assemble various items of equipment or material. (See Appendix 3, Test 2b) Many such tasks were identified.

Some of the Simulated Dangers in CSA Test 1



One of the Assemblies set up in CSA Test 2

From the analysis it was clear, however, that they could all be grouped into three categories.

(i) those requiring the teachers to assemble items of glassware,

(ii) those requiring them to assemble items of electrical apparatus, and

(iii) those requiring the cutting, folding or bending of materials such as paper, rubber, wire and sheet metal.

Representative tasks were selected, from the teacher's guides for each of the three categories. (The second photograph on page 27 shows one of the assemblies set up by the teachers during Sub-test 2b).

Sub-test 2c. In the WISC teacher's guide there is a recommendation that the PUPILS should be able to take measurements to an accuracy of $\pm$ 2 %. It is reasonable to expect teachers to be able to use the same instruments to at least that degree of accuracy. Measurements of length, volume, weight, temperature and time are needed throughout WISC and SDSP so it was decided that Sub-test 2c should test the teachers' abilities to take such measurements to the recommended degree of accuracy.

Test 3 To test the teachers' competence in Skills 3, 4 and 5.

In this test we assess the teachers' skills in,

guiding pupils to make conclusions from their observations,

encouraging pupils to record what they have observed,

relating new experiences to pupil's previous experience.

A number of constraints had to be considered, however, before this test could be developed. CSA tests must take place under standardized conditions but how could we measure a teacher's behaviour with a 'standardized' class of pupils? We could standardize or control the conditions by having different teachers teach the same class in the same laboratory, but would have had to vary the content for each teacher. If we wanted to standardize the content, we would have to use a different group of pupils for each teacher. Different pupils would have different abilities and backgrounds and so the test conditions would not be standard. We decided that the best alternative would be to get the teachers to teach the same content, in the same laboratory using identical sets of apparatus but teaching to different - though similar - groups of pupils. The teachers would be asked to prepare a lesson on a given topic, to a group of children of specified age and ability. They would be provided with identical sets of equipment and given a specific objective which the pupils should have achieved by the end of the lesson. Having prepared written notes on the lesson the teachers would then be asked to teach their lesson to a small group of pupils randomly drawn from the same age and ability 'band' of the one school.

The teachers' skill in relating new experiences to the pupil's previous experience will be judged from the way they propose to do this in their lesson plan. Their skill in "guiding" pupils to draw conclusions from their own observations will be judged both from the way they propose to do it and from the conclusions that the pupils write. Lesson notes and pupils' written responses will also be used to assess the teachers' skill in encouraging the pupils to record their observations.

Test 4 To test the teacher's skill in adapting lessons to suit local conditions.

Of the two science programmes taught by ESP teachers, one, the SLSP programme of the community high schools was specifically designed to suit conditions in Guyanese schools. It requires a minimum of equipment and the lesson plans can be followed in almost every school without major modification. The WISC programme, however, was originally designed for use in Trinidadian and Barbadian schools and was piloted in only a few, relatively well-equiped, Guyanese schools. Many of the lesson plans are not suited to Guyana and often the lessons needed to be adapted to suit local conditions. (Brophy and Dalgety 1981). It was decided that as the ESP teachers were much more likely to have to adapt WISC materials in their everyday teaching then in the CSA test we would evaluate their skill in adapting a WISC lesson to suit local conditions. Using random number tables, one of the fourteen units in WISC was selected. After excluding optional and homework lessons, all lesson plans in this unit were then listed and using a random number table once more, we selected one lesson from a list of twenty. The lesson that came to be selected in this way was lesson 14 . 3 Power: the rate of energy conversion. This double period lesson seeks to introduce the pupils to the time factor involved in energy conversion and to get them to record the number of Joules of energy converted per second when they lift loads. The lesson also seeks to introduce the pupils to the Watt as a unit of power. WISC teacher's guide sets out the lesson plan in detail. The major activity of the lesson involves the pupils using a block and tackle and a stopwatch to lift a set of weights. Almost certainly the schools in which the ESP teachers teach will/neither a block and tackle nor a stopwatch. Test 4, therefore, will measure the teachers' skill in adapting a lesson to suit local conditions by the way they are able to adapt this WISC lesson to suit a (common) local condition of shortage of equipment. In the test the teachers will be given a photocopy of the WISC lesson plan and asked to adapt it so that the same objectives can be achieved by a relevant class of pupils without the use of a block and tackle or stopwatch.

Stage D Procedure Used for Testing Teachers' Criterion Performance

For the CSA tests to be carried out under standardized conditions it was necessary for all the teachers to be tested in one place. The twenty-nine ESP 'graduates' come from many different regions and it was not possible with the finance available to bring all of them to one centre for testing. It was decided, instead to evaluate the performance of a sample of fifteen of them. However, since some of the teachers lived at considerable distances from the capital and since the postal services in the rural regions were not reliable it was thought best to invite a large sample to participate than was actually required for the test. The names of all twenty-nine graduates were placed into three groups according to region (Region 1 Georgetown and East Coast Demerara, Region 2 West Coast Demerara and Essequibo and Region 3 Berbice). A sample of six names was drawn randomly from each list. Eighteen 'graduates' were invited to participate in the CSA evaluation. The tests were carried out over a three day period in January 1981 at Queen's College in Georgetown, with teachers from Region 1 being tested on the 26 th, those from Region 2 on the 27 th and those from Region 3 on the 28th. The tests were carried out in the same laboratory and in the same order for each group. Of the eighteen people invited seventeen arrived for the test, one of whom had to leave to attend a funeral after completing only two of the four tests.

Test 1 Procedure

In test 1 the twelve potential dangers were simulated in the school laboratory. The teachers were provided with Worksheet 1, 'Safety in the Laboratory' @ and were required to identify the dangers , record them on their worksheet and suggest a way in which each could be prevented or overcome.

Test 2 Procedure

For Sub-test 2a the sample of items of WISC and SDSP equipment were placed on a bench along with a number of other items randomly selected from the list of equipment. All items were then numbered. The teachers were provided with Worksheet 2, 'Identifying Science Apparatus' @ on which the names of thirty-one items to be identified were given. They were then required to identify each item by writing its number alongside the name on the worksheet.

In Sub-test 2b each teacher was provided with Worksheet 3, 'Assembling Science Apparatus' @ and assigned a position at a laboratory bench. Each person was provided with the individual items of apparatus and required to assemble them as specified in the worksheet.

@Copies of the Worksheets used for the situational tests are given APPENDIX 3

In Sub-test 2c the teachers were provided with Worksheet 4 'Using Science Apparatus' and were asked to take five measurements using the five different instruments. The teachers were informed both verbally and on the worksheet that marks would be awarded for the accuracy of measurement.

After completing Test 2 the teachers were allowed a lunch break of one and a half hours. The group from Region 3, however, preferred to take a break of only half an hour so that they could complete the tests in time to 'catch hire-cars' (taxis) to Berbice.

Test 3 Procedure

The teachers were given Worksheet 5, 'Science Teaching Methods' and asked to spend thirty minutes preparing the lesson plan. Originally it had been planned to select at random pupils from the entire first form of the school for Test 3. The size of the school's first form and the constraints of the school time table however made this unrealistic. The first form of the school was grouped into three ability bands with the middle band consisting of three classes; within each band the pupils were unstreamed. The procedure adapted for Test 3 ,therefore, was to select twenty-four pupils from one middle-band class each day and then randomly ascribe four pupils to each teacher (so each day six teachers taught four pupils) . All the teachers taught at the same time but in different areas of the same laboratory. They were provided with identical sets of equipment and were asked to teach for the same length of time (a single thirty minute school period).

Teaching in the same room as others is not an unfamiliar experience to teachers in secondary schools in Guyana. Most, if not all, ESP teachers can expect at some time in their career to teach in an open area shared by more than one class. The conditions for Test 3, therefore, reflect the real life situation in Guyana.

Test 4 Procedure

In Test 4 the teachers were given a copy of Worksheet 5, 'Adapting a Lesson Plan to Local Conditions' and a photocopy of lesson plan 14.3 from the WISC teachers's guide. In the guide a number of alternative activities are suggested for this lesson. These, however, were not included in the photocopies provided for the CSA test. The teachers were asked to write a report on how they would modify the lesson if they had neither a block and tackle nor a stop watch.

Scoring Criterion Performance

It has been suggested that scoring is probably the major technical limitation of a situational test (UIE 1979). It took a considerable amount of time and effort to develop a scoring procedure for the ESP tests. One concept which was found to be of benefit was Fremer's (1973) suggestion of minimal competency levels. Using this approach a minimal standard is pre-specified, a standard which a candidate must achieve before he can be judge as being competent to do the job for which he was trained. The problem is now to specify what this standard should be. Zieky (1973) has identified seven different ways in which standards can be set for criterion reference tests. These include 'inspection-based' judgements (in which the tests are reviewed as they are performed) and 'judgemental ' methods (in which the test items are assessed by a panel or committeee of judges and a consenus arrived at). Both judgemental and inspection-based methods were used to develop the marking scheme for the ESP tests. A panel of three judges was appointed to draw up the marking scheme. One member of the team represented the Science Unit of the Ministry of Education, one the Course Writing Team and the third the local tutors. All three were also members of the panel of assessors appointed by the Board of Examiners to make the final teaching assessments of ESP and College of Education students. This Criterion Panel met in Queen's College while the CSA tests were being carried out. They read the materials, observed the tests and then met in a separate room to discuss the scheme. If they had difficulty in arriving at a consenus they obtained a sample of the candidates' ' scripts' and used these to reach final agreement. The Panel provided detailed marking schemes for each of the six skills. As well as setting minimal competency levels for each they also identified levels which would denote a high level of competence in each skill.

Problems Encountered During CSA Test

It took longer than anticipated to assemble the equipment needed for the situational tests with the result that, although some piloting had been carried out, on the spot piloting of the tests was not as thorough as one would have wished and a number of practical difficulties arose during the situational testing; difficulties may well have been eliminated with proper piloting.

The three main problems encountered were,

(i) Difficulty of keeping conditions standardized

In a research laboratory it may be comparatively easy to maintain standardized conditions but in an effort to reflect the authenticity of real life the CSA tests were carried out in an normal school laboratory

and here it is much more difficult to maintain standardization . This was particularly noticeable in Test 1 which measured the teachers' safety skill. One of the 'dangers' which the teachers were expected to recognize was that a reagent bottle sitting at the edge of a bench could be easily overbalanced and its contents spilt. Each day the 'dangers' were checked before the first student was allowed into the laboratory. On the first day, however, we failed to keep checking that the dangers 'continued to exist' for each student and only at the end of Test 1 did we discover that at some time during the test, one of the teachers had moved the reagent bottle slightly back from the edge of the bench. This may have made the 'danger' more difficult to recognize for the other teachers. On the second day of tests we observed one of the teachers picking up the bottle to read the label and then setting it down slightly further back from the edge. Difficulty in maintaining standardization was also reflected by the fact that the teachers noted 'dangers' of which we were not aware. For example, on the first day the seat of one of the pupils' stools was broken and the 'emergency' exit locked.

(ii) Differing interpretations of instructions

In order to maintain standardization over the three days the instructions for the tests were printed on worksheets and verbal instructions kept to a minimum. It was difficult to be sure, however, that each candidate was interpreting the instructions in the same way. In Test 4 , for instance, in which the teachers were asked to modify a lesson plan, some interpreted the instructions to mean that they had to write out a new lesson plan whilst others intrepreted them as meaning that they had only to write about the modifications they would make. Fortunately, the Criterion Panel were close by and able to give a judgement which was then announced to all the candidates.

(iii) Fatigue

Many of the teachers were noticeably tired by the time they came to do Test 4. In order to arrive at the test centre for nine a.m. some had left home at six-thirty a.m. and had travelled distances of up to a hundred miles. Most had taken only small snacks for lunch and so by the time Test 4 began they were clearly fatigued.

One benefit of having the Criterion Panel present at the test centre was that they could observe the problems at first hand and could make allowances for them in the marking scheme. The difficulty of standardization, for example, was recognized and the 'bottle at the edge' danger was weighted accordingly: allowances were also made for valid alternative dangers noticed by the teachers.

Results of the CSA Test

Using the marking scheme and the criterion standards set by the Panel we were able to assess the performance of the ESP teachers on a representative sample of the skills considered by Guyanese science educators to be important for teaching science in Guyana. We were able to investigate the extent to which the ESP teachers had achieved overall competence and also their competence level in each of the six skills.

The results of the CSA test are set out in Table 3 in Appendix 4 and are summarized in Table 3a below. From the tables we see that all sixteen teachers achieved the level required for minimal competence.

Table 3a Competence of ESP Teachers as Measured by CSA Test

	Competency Level		
	High	Above minimum	Below minimum
Competence			
Subject knowledge	0	15	1
Science methods	7	9	0
Relate to environment	6	9	1
Overall competence	0	16	0

Skills 1 and 2 are different aspects of the same competence - knowledge of subject matter - so we combined the scores for these two skills to obtain a measure of how competent the teachers were in 'Subject knowledge'. From the results we found fifteen of the sixteen to be competent. Similarly, combining scores for Skills 3 and 4 we find all sixteen competent in their use of science methods (with seven of the sixteen demonstrating a high level of competence in this area). From the results for Skills 5 and 6 we find fifteen competent at relating to their pupil's environment. Fifteen of the sixteen ESP teachers were competent, therefore, in all three areas considered by Guyanese science educators; to be of particular importance for science teaching. All the teachers scored above the level needed for minimal overall competence. Since these sixteen were a representative sample of the twenty-nine who have so far qualified through ESP we conclude that the programme has achieved its major goal of training teachers to teach WISC and SISP.

CSA as an Evaluation Method

Using CSA to evaluate ESP has shown that the programme achievded its major goal but for the purposes of this case study it was even more important to evaluate the CSA method itself. We approached this by addressing ourselves to certain questions.

Plan for Evaluation of CSA

Validity and reliability

(a) Is the CSA test accurate ?

(b) Is it consistent ?

Opinions about CSA

(a) Does it satisfy administrators and staff ?

(b) Do the teachers tested feel it was fair ?

Overview

(a) What are the strengths of the CSA method ?

(b) What are the main problems, difficulties and limitations ?

(c) How can CSA be improved ?

Validity and Reliability

Before claiming the satisfactory results of the CSA test : demonstrated that ESP has achieved its main goal it is necessary to show that the CSA method itself was a valid measure of the teachers' school performance on this occasion. We need to demonstrate that there is a positive relationship between the CSA test and the teachers' teaching of science in their schools. A method commonly used to demonstrate the validity of a new test depends upon correlating the results of that test with results of an independent and previous test, one which itself has been shown to be a valid measure of the behaviour under test.

Concurrent Validity

In order to demonstrate concurrent validity for the CSA test, therefore, we need another independent measure of the ESP teachers' performance. Unfortunately, the other measures that are available, have not themselves been shown to be valid. If we compare the CSA results of the sixteen ESP teachers with the grades they were awarded in their final teaching assessment we find that there is a weak correlation between the two measures ($\rho = 0.11$). Final teaching grades, however, were decided using ratings obtained from a panel of supervisors who observed the teachers in their individual school. Different teachers were rated by different supervisors, in different situations and in a process that took place over a period of three months. That there is such a low correlation between CSA test results and final teaching assessment is not surprising in the circumstances. Indeed there is little evidence to show that supervisors' ratings can measure a teacher's everyday teaching (Rosenshine 1971).

One way in which we might expect to find a higher correlation of results would be by comparing those obtained in the CSA test of 'Science knowledge' with those obtained in the final(written)examination in science and indeed there is a significant positive correlation between the teacher's competence in subject knowledge (as measure by their combined scores on Skills 1 and 2) and the score they obtained in their final science examination ($r = 0.53$ $p < .05$). [see Appendix 4 for full correlation matrix]

We cannot say,however, that the final science examination itself was a valid measure of the teacher's ability to teach for the scores in the science examination were obtained using the pencil and paper techniques that we noted earlier depended upon indirect symbolic responses.

McClelland (1973) has proposed that the criteria for establishing the validity of criterion reference tests,

> "really ought to be not grades in school, but 'grades in life' in the broadest theoretical and practical sense."

The problem,however, is to determine a way in which 'grades in life' can be determined for Guyanese science teachers.

Predictive Validity

Clearly it would be best to go to their schools to find out how well the ESP trained teachers performed in their 'job situation'. We felt that it would have been of little benefit simply to observe them teaching and rate their performance as this was how the final teaching grades were obtained. A second major problem with the rating technique was that it would have given us a measure of teaching based on a single observation of the teacher's performance. While'real life' may be made up of a series of single events, a teacher's on the job 'everyday' performance is liable to vary greatly from that demonstrated in a single special 'command performance' before a visiting supervisor. We felt that an accurate rating of a teacher's everyday performance could best be obtained from those who observed this everyday performance; those who work with him in the school, his fellow teachers and pupils.

The great majority of schools in Guyana are still based on a traditional authoritarian model with decision making power within the school being firmly held by the headteacher. In a few of the larger schools, there are heads of department to whom some authority is delegated but in general those who are likely to know about a teacher's performance are head teachers on the one hand and pupils on the other.

Interviews with Headteachers

Interviews were conducted with the headteachers of fifteen of the ESP teachers who took part in the CSA test. The interviewer was well known to all the headteachers concerned and they were assured that their comments would be treated confidentially and not disclosed to the teachers or Ministry of Education personnel. In a few of the larger schools the headteachers asked for the head of the science department to be allowed to take part in the interview. At the time of interview the headteachers did not know the results of either the CSA test or of the final teaching assessment and examination grades awarded to the teachers. They did know,however, that the teachers had been awarded teaching certificates. During the first part of

the interview the headteachers were asked to ,

"Tell me what do you think about ---- as a science teacher?"

After they had finished discussing their general comments they were asked specific questions relating to the ESP teacher's class control ,lesson preparation, confidence in subject, and ability to teach higher forms.

From the replies it became clear that the headteachers assessed the teachers mainly on their general attitude, maturity and confidence. They spoke about their 'good' teachers as being 'keen', 'dedicated' , 'confident in himself', 'firm - not hesitant', 'very confident in his work' . When they were critical of teachers , however, they referred to them as being 'nervous and hesitant', 'hasn't matured as a person,still childish ', 'a bit emotional'.
Of the eleven heads interviewed only one had ever taught sciences, most were hesitant to discuss topics especially related to science teaching. They felt unable,therefore, to comment on two of the three competences tested in the CSA test, 'Use of Science Methods' and 'Relating to Pupil's Environment'.

The replies to the four specific questions are summarized in Table 4 Appendix 4 . Twelve of the fifteen teachers were said to prepare their work well; all were seen as being confident in content although the heads felt that four would need some help to teach fifth form classes. Ten of the fifteen were regarded as having good class control and twelve were reported as being willing to teach GCE forms. From the interviews it is clear that all the teachers were regarded by their headteachers as being suitability confident to teach WISC and SDSP. Most were also considered to have good class control and lesson preparation . The interviews and the general findings of the CSA test agree closely. From Table 4 in which the teachers have been ranked according to their CSA results, we can see that, only two of the thirty-two replies to specific questions about the teachers in the top half of the table were unfavourable as compared with eight unfavourable replies given about teachers in the bottom half of the table. Indeed there were more unfavourable replies about the four teachers scoring the lowest marks on CSA than for all the other twelve teachers.

From notes made during the interviews, we later found a more specific correspondence with the CSA results. In Guyana, as in many developing countries, headteachers tend to give the higher ability classes to the teachers in whom they have most confidence, especially with regard to their academic and subject knowledge. In Guyanese schools a good measure of a headteacher's confidence in a teacher's subject knowledge would be whether or not he timetables that teacher to take a GCE class. If we compare the results

obtained by teachers who taught GCE classes with those obtained by teachers who do not teach GCE,on tests 1 and 2 we find strong evidence to support the view that the CSA tests were a valid measure of the teacher's subject knowledge. This comparison is made in Table 5 Appendix 4 and summarized in Table 5a below. We find that there is a strong and highly significant relationship between the CSA results for 'Subject knowledge' and the headteachers' perception of this, as judged by whether or not he time-tables the teacher for a GCE class. (r_{pbi} = +0.8 $p < .001$)(t =4.8 for 13df).

Table 5a Correlations Between Different Measures of Teacher's Subject Knowledge

	Science Exam	Headteacher's placement
CSA	+ 0.53*	+0.8 **
Science Exam	-	+0.42

* $p < .05$
** $p < .001$

Pupils' Opinions on Teachers

The opinions of pupils and students have been used in a number of studies into teacher effectiveness (for reviews of these studies se Costin,Greenough and Menges 19 71, and Strumph and Freedman 1979). Costin et al in their review concluded that,

> ".....student ratings can provide reliable and valid information on the quality of courses and instruction"

Strumph and Freedman, however reported that the results obtained from pupils' opinions were 'inconsistent'. They suggested that student or pupil ratings related to the teacher's strictness or leniency when marking examinations, especially if the teacher's grades affected their chances of getting a high school diploma. This does not apply in Guyana where pupils sit for 'external' examinations and teacher's grades do not affect the final certificate grade.

We wanted to investigate how pupils opinions about teachers would correlate with the CSA results but it was difficult to find a satisfactory means of doing this. Initially, we had planned to use a rating scale similar to

the one developed by Tamir and Zoor (1977) in Israel; their work,however, has been carried out on pupils who all belonged to the one age group. From our experience, and from our contact with the schools, we knew that it was unlikely that the ESP teachers would all be teaching the same age group. The pupils were likely to come from different age groups, races and cultural environments. Pupils from such widely differing backgrounds we felt, would be likely to place different interpretations on the meaning of words and phrases used in a printed rating scale, and wording that was to be understood by (low ability) first form pupils was likely to be seen as childish and naive by fifth formers. So we rejected the idea of developing a rating scale.

We decided,instead, to ask the pupils to give a 'free response' written report of about half a page in length on,

"My science teacher and the way he (or she) teaches science."

This method, while it provides less precise measurements than a rating scale of the teacher's personality, has the advantage of allowing us both to compare the pupils views with the CSA results and to investigate the perspective of the pupils. A science teacher's performance in Guyana could be affected by factors not identified in the opinions expressed by the science educators and headteachers. The pupils' free response replies provided any opportunity for them,perhaps, to emerge.

Classes taught by fifteen of sixteen teachers who did the CSA tests were visited. As was noted above,we could not obtain reports from children all of the same age group but whenever possible reports were obtained from pupils in form 3. In all cases the reports were collected when the teacher was absent. Pupils were assured that their reports would be treated in strict confidence. They were also asked not to identify their teacher by name and were told that the study was being carried out on behalf of UNESCO - an'overseas agency' who wanted to "know about the different methods that teachers use to teach science".

Written reports were obtained from 443 pupils; an average of thirty for each teacher (range 9 - 50). Each report was read by the evaluator and then catagorized as being either 'favourable', or 'neutral' , or 'unfavourable' about the teacher. 371 (84.%) were found to be favourable about the teachers, for example, describing them as being, 'interesting' , 'helpful', 'courteous and attentive'. 58 (13 %) describe the teachers and their work in terms which were neither favourable nor critical,for example, 'teaches me about living things and non living things' or 'he tells us what the topic is' and

what we are going to experiment on ". In fourteen (3 %) of the reports criticism was expressed about the teachers.

> "He is very good in science but I am experiencing that he does not know how to explain himself."
>
> "..but something I found out, bad about him is that he does not go according to the syllabus ."

During the first reading of the reports common 'key words' and phrases were identified and noted. The scripts were then reread to see how many students used these 'key words' or phrases to help describe either their teacher or his teaching. Care was taken to include only specific references to the teaching. Phrases such as "I like the way he teaches me" and he is a "good man" or is "good to me" were excluded. Even so 48 % of the pupils reported that the teacher was either 'a good teacher' or that he taught 'well'. The analysis is not yet complete but the results obtained so far are interesting. There is an extremely low and negative correlation between the percentage of pupils in a class who wrote that their teacher was either a 'good' teachers or taught 'well' and the scores obtained by that teacher on the CSA test. However, there is also an extremely low correlation between the pupils' reports and final teaching assessment grades.

Table 6 Correlations of Three Measures of Teacher Performance

	Teaching Assessment	Pupils' Reports
CSA	+ 0.11	- 0.05
Teaching Assessment	-	+ 0.07

We sought to find a relationship between any of the key phrases used in the pupils' reports and teacher's CSA performance of individual skills and could find no word or phrase in the reports which could be used as a direct measure of subject knowledge. We hypothesized however, that teachers who scored highly on Skill 2 - Use of Apparatus - would be more likely to use apparatus in school than those who obtained low scores for this skill. A greater percentage of their pupils could be expected, therefore, to write about the teacher's use of apparatus. On analysing the data, however, we found no evidence to support the hypothesis. As with the rating scale, the problem stems largely from the fact that the ESP teachers were teaching in so many

different schools and to such a range of pupils. For example, a number of the teachers who scored highly in the CSA tests, taught in schools which did not have functioning laboratories, others taught GCE classes without having the equipment for the course. On the other hand, some of the teachers who scored the lowest marks of the two CSA tests taught only junior classes in schools which were equipped for this.

During the initial reading of the scripts it was noticed that many of the pupils reported on the written work they did in science. Since one of the CSA tests measured teacher's ability to encourage pupils to record their observations it was hypothesized that there would be a significant relationship between the percentage of pupils in a class reporting the recording of work and the teacher's CSA score for Skill 3. Such a correlation did exist, although it was not significant at the 5 % level ($r = + 0.32$).

A point of interest did arise, however, when we divided the set of scripts on the basis of teachers being reported to have 'called out' or written notes on the blackboard from those reporting teachers as encouraging pupils to write their own notes. The CSA test, as well as providing a measure of the teacher's skill in encouraging pupils to 'record' observations, had also provided a measure of their skill in guiding pupils to make their own observations (Skill 4). We hypothesized that teachers who frequently dictated notes - either verbally or on the blackboard - would be unlikely to encourage their pupils to draw their own conclusions from their observations and so could be expected to score poorly on the test for Skill 4. There is, in fact, a negative correlation between the percentage of pupils who report that their teacher 'dictated' notes and the teacher's score in guiding pupils to draw conclusions from their observations. ($r = -0.37$, not significant at 5 %).

Teachers who were reported by the pupils as encouraging them to write notes did score highly on the test for encouraging pupils to record observations. If they were reported to be dictating notes, however, they scored poorly on the test of their skill in guiding pupils to draw conclusions from their observations.

We find there is little correlation between any of the three measures of teacher performance shown in Table 6 but there is reason for believing that the CSA test was a valid measure of the ESP teachers teaching performance. There is a significant relationship between the CSA test scores on science knowledge and the final examination scores for science. There is also a significant correlation between the results of the CSA tests for Skill 1 and 2 and the headteachers' views of teacher competence. Both pupils' reports and interviews with headteachers further substantiate the CSA finding that ESP teachers can competently teach WISC and SDSP.

Reliability of the CSA Test

Although CSA has been shown to be able to effectively measure the competence of the ESP teachers as yet we have shown no evidence that it is a reliable measure of competence. Traditional indices of consistency are not appropriate for criterion referenced tests (Popham and Husek 1969) as the indices were designed for use with norm referenced measurements, and depend upon the existence of differences among the candidates' scores. Criterion-referenced tests are intended to apply to situations in which there may be no difference among the students' true scores. In a CSA test, for example, it could happen that all the people in a population are above the criterion score and thus the true score variance will be drastically reduced or even could be eliminated completely. A CSA test, therefore, could reliably indicate that all the candidates have demonstrated the criterion performance but still have a conventional reliability co-efficient of zero.

The problem of obtaining a reliability index for a criterion referenced test has been recognized for some time and a variety of approaches have been proposed (See Hambleton et al, 1978). For anyone familiar with conventional reliability measures the criterion method which is probably the most appropriate is the one developed from classical test theory by Livingston (1972).
In this method a reliability co-efficient is calculated based on the deviation of scores from the criterion rather than from the mean. Calculated in this way the co-efficient will have many of the important properties of conventional norm-referenced reliability measures including its interpretation as a ratio of variances. It has been argued, however, that as Livingston's co-efficient is a function of the criterion as well as of an individual's responses, it should not be interpreted as if it were a conventional reliability index. (Shavelson et al 1972). Never-the-less , the Livingston method for calculating reliability is recommended by UIE (1979) and especially so for criterion tests where only a single administration of the test is possible.
The CSA results for ESP were obtained from a single test and so Livingston's method was used to calculate reliability. The co-efficient obtained was $\hat{K}^2_{(xT)} = 0.9$, demonstrating a high degree of reliability for the CSA test.

Thus the CSA test used for ESP has been shown to be both a valid and a reliable measure of the teacher's everyday teaching performance and it has been successful in evaluating the major goal of this nonformal educational programme. Although the statistical indices have demonstrated the suitability

of the CSA approach, we felt that more credance would be given to these indices if we could also demonstrate that those who have participated in the ESP programme were satisfied with the CSA method used in the evaluation.

Opinions About CSA

(a) ESP Teachers

Each day after completing the tests the ESP teachers were asked to give written replies to two questions asking how relevant they thought the CSA test were to their everyday situation and how effectively they thought the complete 'package' of four test would assess their ability to teach WISC and SDSP. When everyone had finished writing, the group were invited to discuss the tests. The evaluator led the discussion and made notes of the points raised. The teachers felt that the test was relevant to their everyday teaching situation and many used comments such as 'well proportioned to WISC', 'relevant' or 'closely related to WISC'. A number of the teachers suggested that as well as evaluating skills the tests also provided them with a rewarding learning exercise.

One teacher felt that the test content was biased towards physics and, so , those who taught physics would be at an advantage. In the discussion that day, a number of the teachers disagreed with this comment,however, and suggested that the test reflected the balance of content in the WISC and SDSP programmes. There were a number of criticisms about the length of the test with some teachers reporting that they were too tired to give their best performance in Test 4.

(b) Administrators' and Educators' Opinions

Those involved in the running of ESP were interviewed about the CSA evaluation. One week before the interviews they were provided with a three page discription of the evaluation procedure, asked to read it and prepare comments about CSA's suitability for evaluating ESP. Amongst those interviewed were members of the Criterion Panel, the Education Officer with overall responsibility for science education in Guyana, the co-ordinator of the ESP programme, science education officers who had helped supervise and assess the teachers, members of the Course Writing Team and local ESP tutors. All the people interviewed had received copies of the Science Educator's Questionnaire used in developing the test.

Administrators Views

The administrators felt that CSA could provide a viable means of evaluating ESP.Some concern was felt,however, over the method used to

obtain the views of Guyanese educators. One administrator reported that it had been extremely difficult to rate the skills in the questionnaire since there were so many different schools in which ESP teachers could be asked to teach and what could be a highly important skill in one situation would be of relatively minor importance in another. A second administrator felt that the questionnaire should have been developed using only Guyanese sources and opinions rather than being based on opinions and results from developed countries. The problem of obtaining a true measure of a teacher's performance from a single observation was commented upon.

Supervisors' Views

Supervisors felt that the main benefit of the CSA approach lay in its ability to test a teacher's performance in a practical yet controlled way. The test of safety skills was particularly praised. One supervisor,wondered whether CSA could measure a teacher's 'willingness' or 'attitude' to perform a skill rather than his ability to perform that skill. Thus, it was suggestai that the best measure of a teacher's performance should be what he actually does rather than what he can do. Another supervisor felt that there had been a bias towards physics content in the test and suggested that we should have,

> "Sacrificed statistical purity of randomness to get a more deliberately representative sample of the skills."

Unlike the administrator quoted above,one of the supervisors felt that <u>too much</u> attentation had been paid to the views of the Guyanese educators in developing the CSA test and as a result the evaluation had been too narrow. It told us, he suggested, only about the teacher's performance on skills thought to be important by Guyanese. Surely, he argued, these were the skills that teachers were most likely to have since if the educators thought they were important they would be the ones emphasised in the training programme. What if educators in other countries, felt that other skills were more important ? Would the ESP teachers have these skills ? If not can they be said to teach WISC and SIESP effectively ?

Views of Local Tutors

The local tutors felt that the CSA approach used would provide a good evaluation of the Emergency Science Programme. They liked,especially, the two tests related to subject knowledge and suggested that tests of the different skills would help in diagnozing weaknesses in training. One tutor felt that the marking scheme should have allowed for some marking to be done on an observational basis, with assessors rating the teachers' performance on the different skills. It was also suggested that the equipment used in

Test 2 could have caused some problems for students from rural regions. It was pointed out that there is no one source of equipment for Guyanese schools and during the past decade science materials have been purchased from the U K , the USA, Canada, GDR and the Republic of China. While all the teachers could be expected to be familar with a lever balance, the UK model used in the test itself could be unfamilar to them and would place those who were familar with ; for example, the Canadian model at a disadvantage.

Course Writers' Views

The Course Writing Team members felt that CSA was a 'very promising evaluation method' and that it could provide a valid evaluation of the ESP programme. They disliked the fact, however, that the assessment of the teachers was made on a 'once and for all basis' and suggested that this could effect the reliability of the assessment since a teacher could be demonstrating an atypical performance of his ability. The role of the Criterion Marking Panel they regarded as being crucial in a CSA evaluation and suggested that great care should be taken in selecting the mebers of the panel. They should be people 'steeped' in the actual performance and knowledge of the skills being tested and yet at the same time they cannot be people who are so 'set in their ways' that they are unable to rethink or change their minds after discussion and reflection. People with this combination of experience and flexibility it was suggested were rare and yet were essential for good CSA evaluation.

Case Study Team's Overview

Appropriatness of the CSA Evaluation of ESP

The CSA evaluation has produced tangible results to demonstrate the success of the distance teaching method in training science teachers in Guyana. Analysing the results we have seen that the CSA test was highly reliable ($r_{tt} = 0.9$) and made a valid assessment of the teachers' abilities. The findings correspond to the 'traditional' examination scores ($r = 0.53$) and to headteachers' and pupils' opinions. Participants in the ESP programme including students, local tutors, supervisors, course writers and administrators all felt that the methods and instruments used could evaluate ESP. A number of criticisms of the method were made by participants and these have been outlined.

It is appropriate at this stage of the report, therefore, to take an overall look at CSA's suitability for evaluating ESP, taking into account the results and opinions obtained and our own experience indeveloping and carrying out the evaluation.

Strengths of the Criterion Sampling Approach

During the case study we have become aware of six main benefits or advantages of the Criterion Sampling Approach. These are:

1. Using CSA we are able to obtain direct 'low inference' measures of teacher's performance, measures which give us absolute rather than relative judgements about performance. We now know that ESP teachers are competent to teach WISC and SDSP on the skills that we measured. Other methods have merely given us relative data, such as whether or not the ESP teachers were as 'good' as other science teachers or whether or not the particular teacher was in the top twenty percent of his age group. The CSA criterion tests can be used year after year to assess different groups of teachers yet each future test will indicate the competence of the teachers in the particular group on the particular skills.

2. By using situational tests CSA enabled us to evaluate teachers from many different schools and areas, under controlled conditions. Carrying out ratings of ESP teachers in their normal classroom situation has proved to be very difficult throughout their training period. For example, a supervisor could be asked to rate teacher A who is teaching a GCE physics class without equipment in a crowded hall. Later the same morning he may be required to assess a second teacher teaching a form 1 class in the well equipped laboratory of a new secondary school. In awarding a grade the supervisor is faced with the problem of judging whether teacher B's performance in his school situation was as good as Teacher A's performance in his situation. With the CSA test each teacher was tested under standardized conditions.

3. CSA enabled us to obtain a measure of the teacher's ability using tangible concrete measures of performance. When assessing a teacher's competence in a normal classroom situation the supervisor is faced with the difficulty of having to observe many different skills at the same time. The grade is awarded on how well the complex of skills have been demonstrated but often this can only be judged on rather intangible evidence; "the pupils' level of attention" , "the general productive atmosphere", "the teacher's stumbling speech". CSA allowed us to isolate the different skills needed to teach WISC and SDSP and assess the teacher's ability to do this using clearly observable indicators of performance. For example, did he or did he not show how to overcome a specific danger ? Could he get the four pupils to record their observations ?

4. Criterion Sampling permitted an element of diagnostic evaluation. By testing the teacher's performance on a number of different skills we are able to see how effective the ESP programme is in developing each of these skills. The information obtained serves, therefore, as a formative as well as a summative evaluation. This was particularly beneficial since a third intake of students were about to begin training and the information obtained from CSA could be used to help modify the programme. In distance teaching it is often difficult to get first hand information about the learning difficulties of students. Often organizors are dependent on local tutors and teaching supervisors noting and relaying detailed information about the students capabilities

5. One point which came over very strongly in the interviews with the ESP participants who were members of the Criterion Panel. was the benefit they felt they had gained from being involved in this procedure. They felt it had helped them to 'rationalize' what they wanted ESP to do. Although many of the correspondence units had provided the students with specific objectives and although there were general aims for the programme, the course organizors had not previously considered what competences and skills ESP should seek to produce in its 'graduates'. Working on the Criterion Panel they felt had helped them to do this and would, in future, help them in directing ESP

6. Using Criterion Sampling continually to evaluate the ESP programme would have a dramatic impact on the motivation of the students . If they knew they were to be assessed on their performance of tasks and skills directly related to their job then they would be more likely to practise and try to improve upon their performance of these rather than merely trying to improve upon their academic knowledge for examinations or in trying to prepare a 'one off' special lesson for the benefit of a visiting supervisor.

Limitations of the CSA Evaluation

As well as having particular strengths the CSA evaluation also had a number of weaknesses and limitations as we applied it. Although they may or may not be limitations in future work, they reflect problems we encountered.

1. CSA testing is relatively expensive and time consuming both to develop and to carry out. Other evaluation methods, such as those using examinations, ratings, questionnaires and interviews involve some expense at the development stage but are relatively cheap to carry out. Questionnaires can be posted, examinations held at a

a number of local centres, interviewers can visit a number of schools in one area. Criterion Sampling, since it depends upon students being tested under standardized conditions required that the ESP students be brought to a central testing area. *

Distance teaching , as its name implies, involves students being taught at a geographical distance from the programme headquarters and frequently there are also considerable distances between the areas in which different students live. To bring a body of students from the rural and interior areas of a developing country to a central location is expensive, yet was necessary. Initially we had considered carrying out the tests at the local centres so that the teachers would have had to travel only short distances but as well as the major problem of standardizing conditions at the different centres, other difficulties were anticipated. For example, the ESP teachers had all worked together at the vacation workshops and were familar with their counterparts throughout the country. Once any one batch of teachers were tested information about the test would be spread around the other teachers in a matter of days. We could overcome this only by varying the test content or by carrying out all tests within a two or three day period. In the interests of standarization we did not want to vary the content but we knew that it would be impossible to carry out tests in all three regions in anything less than a week.

2. Because CSA testing is time consuming and expensive only six of the thirty-six skills rated as most important by the educators could be tested. As we have reported, even this proved to be tiring for the teachers. Testing performance on a greater number of skills would have required bringing the teachers back to the centre for a second day of tests and, with the finances and time available, this would have meant reducing the number of teachers who could be tested. We had to maintain a balance, therefore, between the two 'sample' sizes; the larger the sample of skills the smaller the sample of teachers and vice versa. While every evaluation method may have to maintain such a balance, the relative expensiveness of situational testing makes this balance particularly important in CSA evaluation.

3. One of the criticisms leveled at the CSA approach we used, by the administrators and course writers was that it made an assessment of the teacher based on the observation of a single performance. The CSA assessment assumed, therefore, that the teacher's performance on the day of the test was typical of his everyday performance. It is hardly likely, however, that everyone

will give a typical performance on any particular day.
Although sixteen people completed all four CSA tests, seventeen had in fact completed Test 1 and 2. This is because, for example, one teacher had to leave at mid-day to attend a family funeral. To what extent, we may ask, was this teacher's performance on the tests she completed affected by her 'domestic' circumstances ?

Teacher assessment by visiting supervisors can be rearranged fairly easily to allow for any major disruptions to a teacher's domestic or work situation and many modern examinations try to overcome the problem of 'one off' measurement by including in the assessment a percentage of marks gained from continuous evaluation or course work. However, in CSA evaluation, because of the additional expense involved the individual can not be catered for to the same extent

An interesting example of the difficulties arising from assessing someone from a one off performance is demonstrated in the CSA results. In Table 3 Appendix 4 we find that one teacher was below minimal competence on Skills 1 and 6, had the lowest score on Skill 2, and had the lowest score for the overall test. Surprisingly, however, during final teaching assessment this teacher had been ranked as one of the top five in the whole ESP group and was in the top fifty percent in the final science examination.
Her headteacher thought she was a good teacher, who was thorough and methodical, and suggested that her greatest strength lay in her 'ability to communicate effectively with students'. He felt that because of her good 'rapport' with the students they "develop a liking for her and as a result she can get over her content". Indeed thirty out of the thirty-two pupils in her class (94 %) wrote favourably about her. One pupil wrote,

> "She knows how to make our science lesson a very enjoyable one. She knows just how to treat children, she is never harsh and tries to make you understand in the simplest way. Our teacher never rush things and never misses a detail."

Yet this was the teacher who had the lowest overall score on the CSA test.

One clue as to why this might be came from the interview with her headteacher. At the time neither he nor the interviewer knew the results of the CSA test. While discussing her 'hesitant' attidtude towards teaching a fourth

or fifth form class the head commented that he felt that her attitude stemmed from her personality as she was 'pretty sensitive' and 'a bit emotional. ~~On reflection we suggest that the CSA test may have discriminated against this girl because of her personality, in that a single set of 'one off' performance tests could be an unsuitable method of testing the ability of this 'emotional' person.~~ She displayed no fear of the pupils in her everyday teaching. She had had frequent visits from her supervisors during her training and so was not upset at final teaching assessment and she was familar with traditional written examinations. Only the unfamilar performance testing of CSA was new to her and so her personality may have found CSA difficult to cope with.

It is interesting to note that during the interviews headteachers only twice referred to teachers being 'emotional'. The first time was in reference to the teacher mentioned above who scored the lowest CSA mark, and the second time was in reference to the teacher who scored the second lowest mark. An evaluation based on a single performance of a CSA test, we suggest may produce results which are biased against people with a 'sensitive' or 'emotional' personality. If having such a personality is a hinderance to effective science teaching then it is valid for CSA to discriminate in this way. However, from the results we obtained using other methods of assessment this appears not to be the case.

ESP used a multi-media approach to distance teaching. In an evaluation of the programme it would be of interest to know about the relative effectiveness of the different components of the programme. The face-to-face component, for example, was much more expensive than the correspondence component. The organizors would like to know ,therefore, how effective this relatively expensive component has been. How did the teachers acquire the different skills ? Were they obtained via the correspondence units or were workshops and tutorial sessions essential for developing teaching skill ?

Formative evaluation, during the first years of ESP had shown that while 80 to 90 % of the students had thought that weekly tutorials were useful and interesting only 50 to 55 % thought this of the audio tapes which had been specially prepared to supplement the units. Emphasis shifted away from the production of tapes, therefore, and towards the face-to-face component and for the later units local tapes were completely replaced by relevant commercial tapes and slides obtained via the UK Ministry of Overseas Development.

It would be of immense value for the future development of the programme for the organizors to know about the effect of the different teaching components. The CSA evaluation, however, did not provide us with information about this. With hindsight,provision to do so could perhaps have been built into the evaluation procedure, although because of the time and expense involved it is unlikely that all the relevant factors about a programme can be evaluated by CSA.

5. The lack of information about the effect of the different components of ESP highlight what we concluded was the major limitation of CSA evaluation, namely, the restricted range of information it provides. While recognizing that information from any single evaluation method is liable to be limited, we felt that the information from the CSA approach was definitely limited for it''missed' a number of factors which would have been essential for a complete evaluation of the programme.
Four such factors have been identified ;

(i) Teacher's willingness to remain in the local area
One of the major problems with college based teacher training,especially in developing countries, stems from the fact that colleges are based in predominantly urban areas. Students from rural areas often find difficulty in coping with the change to urban lifestyles. For those who do settle, however,the problem is exacerbated by the fact that they may then find it equally difficult to return to a rural lifestyle after spending two or three years in a city environment. Teachers from rural areas who have been trained at Guyana's two colleges of education (primary and secondary) have often been unwilling to return to their local areas,preferring to remain in Georgetown. This phenomenon is not restricted to Guyana. In Russia, for example, 38 % of those who graduated from teacher training institutions in 1979 refused to take up teaching appointments particularly when the appointments were in village schools (Binyon 1980).

By using distance teaching the Ministry of Education was able to train the ESP teachers in situ. This was considered a major benefit of the programme (Brophy and Dalgety 1980) and it was hoped that by being trained in their local environment the ESP teachers would be less likely to want to move to a city environment.. The CSA evaluation has not provided us with any information on this aspect of ESP,but this was not a goal which we had set for CSA to evaluate. We know the teachers are competent to teach WISC and SDSP but will they remain teaching where they are needed or will they leave there rural areas,follow the pattern of the college trained teachers, and 'drift' towards the urban areas ?

It is still hoped that ESP teachers will not follow this pattern and some evidence is available from answers given on questionnaires sent to the twenty-nine ESP and the twenty-two college trained science teachers 'graduating' in 1980. (According to the Board of Examiners twenty-six people graduated fr om the College science programme in 1980 but of these only twenty-two have taken up teaching posts).

Replies to the questionnaires came from 84 % of the teachers (83 % ESP and 86 % College trained) and are summarized in Table 7 below.

From the replies we find that while 42 % of the College teachers wished to change school only 25 % of the ESP teachers wished to do so. More important, perhaps, is the fact that only 29 % of the ESP teachers wanted to teach in the urban based 'Senior High Schools' compared with 74 % of the College trained teachers.

Table 7 School Preference of College and ESP Trained Teachers

	College trained	ESP trained
Wish to change school type	8 (42 %)	6 (25 %)
Wish to teach in Senior High School	14 (74 %)	7 (29 %)

Not only can teachers in rural areas be taught in rural areas but there are signs that they are quite likely to be content to stay there.

Both are important features favouring the ESP programme. The CSA did not tell us about this aspect of ESP; it had not been designed do so.

(ii) Effect of teacher's cultural background on teaching performance

The CSA situational tests told us how competently ESP teachers could teach, but they did not provide us with any evidence that their performance could be affected by their cultural background. Evidence that performance could be affected in this way came from the interviews

with headteachers and from the reports of pupils. Talking about a teacher who came from a rural area a 'city' headteacher, for example, spoke of the teacher's "cultural and environmental upbringing " being responsible for his "lack of rapport" with the children and suggested that his "very sheltered upbringing" had made it difficult for him to cope with the "dynamic" children in a city school. The children themselves wrote of this teacher that he,

> "cannot pronounce words and speak properly"
> "confuses the whole chemistry class" and
> "suffers from a language variation".

This teacher achieved the minimal competence level in all six skills. The CSA test did not tell us about his language "variation". He is competent to teach WISC and SDSP but should he be asked to do so in a large city school? CSA tests cannot identify and demonstrate the effect cultural and racial factors have upon a teacher's performance unless the tests are specifically designed to do so, that is, by collecting information about culture and race.

(iii) Teacher's previous experience and academic backgroun:

When selecting students for the ESP programme two important criteria were used, namely their academic background and their teaching experience. Priority was given, whenever possible, to candidates who had taught for at least three years, and to those who had good academic qualifications in science,mathematics and english. It would be of value , both to programme organizors and to the administrators, when selecting future students to know if there is a relationship between success on the programme and the applicant's initial teaching experience and academic qualifications. Is it necessary to restrict entry to those who have the best O level grades ? Do they become the best teachers ? Is teaching performance related to the person's previous teaching experience ?

We tested a representative sample of the ESP 'graduates' and so can test some hypotheses about how academic background and experience might affect the teaching performance of ESP teachers. Our sample, however,was drawn from the population of successful students. Five people were 'referred' by the Board of Examiners. We do not know about the teaching performance of these (as yet) unsuccessful ESP students. Would they have achieved the minimal competence level ? If they failed on subject knowledge -as tested by the pencil and paper test could they still have been judged competent to teach WISC and SDSP from the CSA tests ? The CSA has told us about the performance of successful ESP students. As used here,it did not provide us with information about the unsuccessful students. If this information is required then it must be designed into the study.

6. During the interviews with ESP participants one of the supervisors had asked could CSA provide information about the teachers' attitudes The CSA we used was not designed to do this. The results tell us how well the teachers <u>can</u> perform. They reassure us that the teachers do have the necessary skills but they do not tell us if they actually use those skills. Because a teacher can encourage children to draw a conclusion from an observation it does not necessarily follow that he actually does it.

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Conclusions and Recommendations

This report describes how a Criterion Sampling Approach was developed and used to evaluate the Emergency Science Programme for Science Teachers. The evaluation forms part of a multi-national project being undertaken by the UNESCO Institute for Education, Hamburg, a project whose main purpose is to evaluate the feasibility and applicability of using the Criterion Sampling Approach for evaluating the learning outcomes of nonformal educational programmes. UIE will be making recommendations about the use of CSA based on the experiences of the three case studies. In the light of experience gained using CSA to evaluate ESP we have drawn the following conclusions.

A. The Criterion Sampling Approach is a feasible and practical way of evaluating ESP.

B. The CSA results are a valid and reliable measure of ESP teachers' competence to teach WISC and SDSP in secondary schools in Guyana.

C. Criterion Sampling has a number of advantages over other evaluation methods. For ESP the major advantage is that CSA has enabled us to obtain, under standardized conditions, direct 'low inference' measures of the competence of teachers from widely different areas and school environments.

D. Criterion Sampling is relatively expensiveand,in common with other techniques has its limitations. So far as the ESP is concerned the major limitation is that information important in the evaluation of ESP as a whole was missed by our approach and came to light only through using other methods of evaluating. Used by itself CSA might provide a narrow and restricted perspective of an NFEP. We have learned that the CSA approach is not a panacea to evaluation. It will only answer the questions that it was designed to answer;additional information is always helpful in evaluation.

Following on from these conclusions and again on the basis of our experience with ESP, we make the following recommendations to UIE.

1. The Institute should continue to develop its interest in CSA and might give its attention to maintaining a directory of those evaluation studies which use the CSA, and to acting as a resource and advice centre for others wishing to use the approach.

We have learned that the CSA approach is not a panacea to evaluation. It will only answer the questions that it was designed to answer; additional information is always helpful in evaluation.

2. While encouraging the use of Criterion Sampling the Institute should also draw attention to its limitations and advise that, in an evaluation of an NFEP, CSA should be supplemented by other evaluation techniques.

3. When advising evaluators about CSA the Institute should stress as crucial, the fact that the situational tests must accurately represent the real life situations for which the candidates have been trained, and should emphasize that it is, therefore, essential for these tests to be either developed or monitored by someone familar with the everyday situation the tests are intended to represent.

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and Criterion referenced Tests
NFER
England 1977

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APPENDIX ONE

Correspondence Units of the Emergency Science Programme

TABLE 8 Correspondence Units of the Emergency Science Programme

Unit No	Title	Number of Pages			Main Content Areas
		Text	Diagrams	Total	
1	Life and the Environment	107	11	118	Science process,case studies on Malaria and germ theory
2	Science,Education and Society	93	13	106	The nature of science, functions of education, case study of CHS schools in Guyana
3	Foundation Mathematics	111	20	131	Number systems,scientific notation graphs,ratio and proportion
4	Energy Matter Relationships (1)	80	12	92	Nature of energy, heat energy,structure and nature of matter,Metric units
5	Foundation English	70	3	73	Communication skills,guided composition, comprehension
6	Educational Psychology	157	16	173	Teaching styles,theories of learning, intelligence and creativity
7	Ecology	95	18	113	Ecosystems,transfer of energy, soils, practical ecology for schools

Unit No	Title	Number of Pages			Main Content Areas
		Text	Diagrams	Total	
8	Teaching Science	83	2	85	Planning science lessons, methods of teaching science, safety in science teaching
9	Energy Matter Relationships (11)	151	20	171	Acids and oxidation, oxidation states, electricity and light energy
10	Metabolism	86	10	96	Characteristics of life; digestion, transport, respiration, excretion, homeostasis and coordination
11	The Curriculum	90	3	93	Defining the curriculum, curriculum theory, other people's curriculum, curriculum development in Guyana
12	Geography For Science	119	24	133	Geography and space science, the Earth-Moon system, finding your way about the Earth, the Earth itself
13	Continuity of Life	104	17	121	Levels of biological organization, Genetic continuity, evolution
14	(A) Revision Education	8	0	8	An analysis of supervisors' reports on students' teaching
	(B) Further Mathematics	42	11	53	Introduction to calculus, vectors, motion in a straight line

Unit No	Title	Number of Pages Text	Diagram	Total	Main Content Areas
15	Electricity and Magnetism	41	19	60	Electric fields and charges, capacitance, permitivity,direct current circuits
16	A Guide to Research and Project Work	85	15	100	Why do projects ? Planning a project, writing up a project
17	Energy Matter Relationships (111)	72	5	77	Gases,vapours and heat energy, elasticity, gravity and radioactivity
18	Energy Matter Relationships (1V)	31	19	50	Applications of chemical processes, raw materials in the chemical industry

APPENDIX TWO

Main Surveys Used in Developing Science Teacher Competences

Main Surveys Used in Developing Science Teacher Competences

Butzow J.W. & Qureshi Z. 1978
Science Teacher Competencies:
A Practical Approach.
Science Education 62 (1)

Bybee R.W. 1973
The Teacher I like best
Perceptions of advantaged, average
and disadvantaged students.
School Science and Mathematics
Vol LXXIII No5 646

Bybee R.W. 1975
The Ideal Elementary Science Teacher
School Science and Mathematics
Vol LXXV No3 661

Chiappetta E.,Shores J.,Collette A. 1978
Science education researcher's perceptions of
Skills necessary for secondary school science
teachers
Journal of Research in Science Teaching
Vol 15 No 3

Chiappetta E.,and Collette A. 1978
Secondary science teacher skills
identified by science supervisors
Science Education 62 (1)

Chiappetta E., and Collette A. 1978
Secondary science teacher skill
identified by secondary science teachers
Science Education 62 (2)

Fairbrother R.W. 1977
Good and poor science teachers;
a cluster analysis of the personalities
of student science teachers and
practising science teachers.
PhD Thesis
Chelsea College
University of London

Gilliam J. and Choppin J. 1977
Teachers for Tomorrow
N.F.E.R.
U.K.

Hayson J.T. and Sutton C.R. 1974
Innovation in Teacher Education
McGraw Hill

Houshill P.B. and Dieter D. 1975
The self-image of outstanding
biology teachers
School Science and Mathematics
Vol LXXV No 3

Lawrenz F. 1974
Science teacher's perceptions of
their teaching skills and their
school conditions
Science Education
Vol 58 No 4

Moore K.D. 1978
An assessment of secondary school
science teacher needs
Science Education
Vol 62 No 3

Simpson R.D. and Brown D.R. 1977
Validating science teaching competencies using the Delphi method
Science Education
Vol 61 No 2

Tamppari R. and Johnson G. 1975
Characteristics of the employable science teachers as percieved by school district hiring officials
Journal of Research in Science Teaching
Vol 12 No 4

Their H.D.
The aims and objectives of teacher education for integrated science including characteristics and competencies of the integrated science teacher
New Trends in Integrated Science Teaching
UNESCO

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In Appendix 2

Skills considered by Guyanese science educators to be most important for science teaching in Guyana.

Subject Knowledge (ranked according to importance)

1 Use correctly all the different apparatus and materials needed for the science curriculum being used by his / her pupils.

2 Observe safety precautions for any situation that is likely to arise in his / her science teaching.

4 Make use of improvised apparatus when necessary.

3 Ensure that information is correct when presenting it to the class.

Random selection ..... Items 1 and 2.

Scientific Methods

1 Encourage pupils to make observations for themselves.

2 Encourage pupils to record what they have observed.

3 Guide pupils to make conclusions from their observations.

4 Encourage pupils to discuss their results with the teacher.

Random selection .....Items 2 and 3

Making Learning Relevant

1 Select and use relevant materials and examples from the local environment.

2 Encourage pupils to bring in materials from the local environment for use in the lessons.

3 Adapt a lesson plan to suit the specific local conditions of a school.

4 Suggest examples of scientific knowledge and skills which are applicable to the social and economic life of the community.

5 Relate new experiences to pupils' previous experience.

Random selection ..... items 3 and 5.

APPENDIX THREE

Worksheets Used for Criterion Sampling Tests

TEST 1 SAFETY IN THE LABORATORY Teacher No _____

In this test we wish to check if the teachers trained via the Emergency Science Programme are able to observe safety precautions for any situation that is likely to arise in their teaching.

In one of the laboratories we have arranged TWELVE (12) potentially dangerous situations which could arise in your teaching. We want you to identify each of the twelve and to suggest a way in which each danger could be prevented or overcome.

In this test the score awarded for each teacher will depend on the number of dangers that are recognized and also on the suggestions made for dealing with them.

	DANGERS NOTED	HOW THIS COULD BE PREVENTED OR OVERCOME
1	.....	.....
2	.....	.....
3	.....	.....
4	.....	.....
5	.....	.....
6	.....	.....
7	.....	.....
8	.....	.....
9	.....	.....
10	.....	.....
11	.....	.....
12	.....	.....

(If you wish you may write on the back of page)

TEST 2 TEACHER NO ____

IDENTIFYING SCIENCE APPARATUS

In this test we wish to check if teachers trained via ESP are able to use correctly all the different apparatus and materials needed for the science curriculum used by their classes.

(A) In the first part of this test we are asking you to identify a number of items of equipment needed in the WISC and SDSP programmes. On a bench in one of the laboratories you will see thirty-seven (37) items of equipment. Each has been numbered. Below you will see the names of thirty-one (31) of the thirty-seven items on display. We want you to identify these thirty-one by writing alongside the name, the number that the actual item bears. For example, if you can see a ring magnet on the bench, look at the number on it and then write that number alongside its name on this sheet.

In this test marks will be awarded for each item identified correctly.

(Please try not to move the items, we want everyone to see them clearly).

NAME OF ITEM		
ring magnet	atomic models	mounting needle
Bunsen burner	filter papers	teat dropper
measuring cylinder	watch glass	resistence wire
boiling tube	microscope	plotting compass
wire gauze	microscope slide(plain)	converging lens
retort stand	microscope slide(cavity)	pestle and mortar
conical flask	plug key	pulley
round bottom flask	dry cell	protractor
dissecting scalpel	bell jar	optical pins
petri dish	filter/vacuum pump	
filter funnel	asbestos mat	

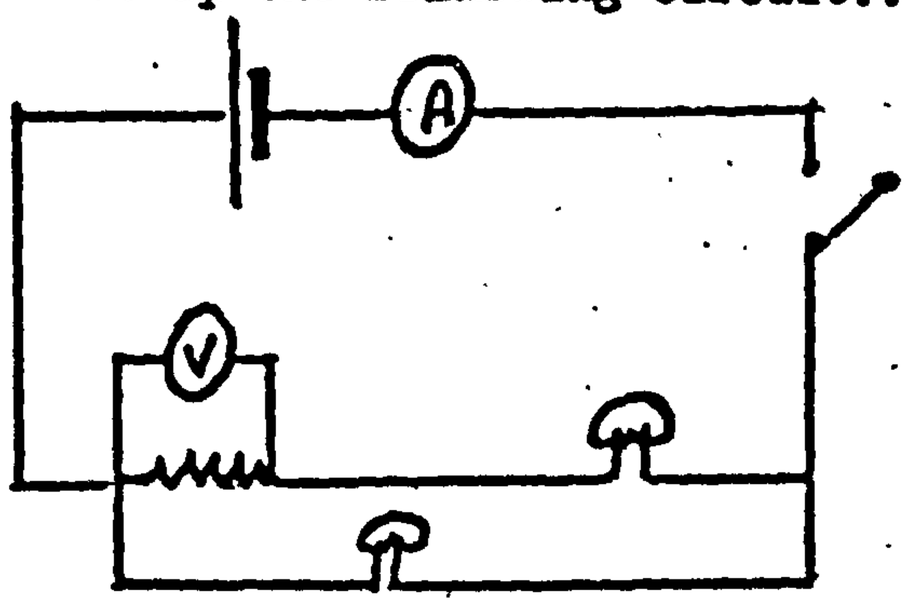
TEST 2 Teacher No _____

ASSEMBLING SCIENCE APPARATUS

(B) In the second part of TEST 2 we are asking you to connect up and assemble three sets of apparatus.

(i) On the bench you will see the following items of electrical apparatus; a plug key, a cell, an ammeter, a voltmeter, a fixed resistance, and two light bulbs.

Use these items to set up the following circuit.....



(ii) On the bench you will see the following items of apparatus; a one-holed rubber stopper, a length of glass tubing, a set of cork borers and a boiling tube
We want you to insert the glass tubing through the hole in the rubber stopper and then insert this into the neck of the boiling tube. One example of the finished assembly is on show for you to see.

(iii) On the bench you will see the following items ; a length of wire, a weight and a wooden rod.
We want you to cut off a piece of wire of approximately 450 mm
Coil it and then attach it to the weight and the rod as shown in the diagram below. Marks will be awarded only for items which are correctly assembled, so please leave your equipment assembled.

TEST 2 TEACHER NO _____

USING SCIENCE APPARATUS

(C) In this part of TEST 2 we are asking you to use some items of equipment as accurately as you can.

We would like you to:

(1) Use the metre rule to measure the length of the string provided to the nearest millimetre.

(2) Use the stop watch to time the sound on the taperecorder to the nearest half second.

(3) Use the measuring cylinder to measure the volume of the liquid given to the nearest .5 cm^3.

(4) Use the balance to weigh the mass of the stone provided to the nearest gram.

(5) Use the thermometer to measure the temperature of the liquid in the boiling tube to the nearest .5 degree Celius.

(Please tell me when you wish to carry out this activity).

Marks in this test will be awraded for the accuracy of your measurements.

1	The Length of the STRING is	_____	m.m.
2	The SOUND on the tape was	_____	seconds.
3	The VOLUME of the liquid was	_____	cm^3.
4	The MASS of the stone was	_____	g.
5	The TEMPERATURE of the liquid was	_____	^{o} C.

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TEST 3 TEACHER NO _____

SCIENCE TEACHING METHODS

In this test we wish to check if teachers trained via ESP are able to:

(a) guide pupils to make conclusions from their observations,

(b) encourage pupils to record what they have observed,

(c) relate new experiences to pupil's previous experience.

To test these skills we are going to ask you to TEACH a thirty (30) minute lesson to a group of four first form pupils in one section of this laboratory. (The other ESP teachers in this group will be teaching their pupils at the same time). The lesson will be based on the pendulum and at the end of it we want your four pupils to have reached the conclusion that,
"If we change the length of a pendulum we change the time of the swing but if we change the weight of a pendulum we do not change the length of the swing".

You must not tell the pupils this. We want them to draw this conclusion from the observations that they make.

You will be provided with : four sets of weights for pendulum bobs, four retorts with split corks and string, four metre rules and one clock or stop watch (with a second hand). You are also provided with some blank paper you can use for worksheets. We would like you to spend about thirty minutes preparing and writing out your lesson plan. We will be collecting the plan off you after the lesson, so please put your Teacher No on it.

In your written plan we wish you to STRESS how you will demonstrate the three skills which this test is assessing. (See a,b, and c above).

At the end of the lesson we would like you to ask your four pupils to write on the bottom of their worksheets - after their other written work - any conclusions that they have made about the pendulum.

We will be collecting your lesson plan, the pupils record of their observations and their conclusions. In this test marks will be awarded for ; the way that you plan to demonstrate the three skills, the way that the pupils record their observations and the conclusions that they make.

TEST 4 TEACHER NO _____

ADAPTING A LESSON PLAN TO LOCAL CONDITIONS

In this test we wish to check if teachers trained via ESP can adapt a lesson plan to suit local conditions.

We have made a random selection of ONE lesson from WISC - UNIT 14 Lesson 3, Power : the rate of energy conversion. We want you to adapt this lesson plan to suit a particular local condition (shortage of apparatus). You are provided with a photocopy of the lesson plan given in the WISC Teacher's Guide. This plan, however, involves the use of a block and tackle and a stop watch. We want you to imagine that you are going to teach a third form class which has been following the WISC programme and that you now wish to teach Lesson 3 of Unit 14.
You have neither a block and tackle nor a stop watch (or stop clock), so you must adapt the lesson plan.

Adapt Lesson 3 of Unit 14 so that the pupils will be able to achieve the same objectives without using either a block and tackle or a stop watch (or stop clock). Write out your new lesson plan.

In this Test marks will be awarded for the way that you have adapted the original lesson as demonstrated by the modified lesson plan that you have written out.

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Time *Location*

2 periods Classroom

Aims

To introduce the time factor into energy conversion, and for pupils to record the number of joules of energy converted per second when they lift loads. To introduce the unit, the watt.

Equipment and Materials

1 strong block and tackle or Weston pulley suspended from an upstairs verandah
1 heavy load (about 400 N) previously weighed on the bathroom scales type balance, and labelled '400 N'. (A load of bricks would be suitable.)
2 metre rules
1 stopclock or watch with seconds hand

Procedure

1 Set the load on the ground, with the pulley attached to it, so pupils can see it. Explain that you have previously weighed the load, and have found that the Earth's pull on it is 400 N.

Discuss how one might measure the *useful* energy converted in lifting a load from the ground to the top floor.

Pupils may respond with 'measure the force used'. It should then be pointed out that all the applied force is not necessarily useful; for instance, some is wasted in overcoming friction. Eventually, pupils will suggest that the Earth's pull on the load be measured. If there is no suitable force measurer available, you can say that it has already been worked out, and you have labelled the load.

Next, elicit the need to measure the distance raised; two metre rules can be used to measure the height of the verandah.

Suggest now that it might be interesting to time the job. After all, workmen often get paid by time, so one could calculate the cost of lifting the load at 60¢ per hour or 1¢ per minute.

Finally, get one pupil to pull up the load, another timing him, two more measuring the height, and one acting as foreman/recorder.

distance raised, d = 3.7 m
time taken, t = 14 s

so useful energy converted, E = FD
= 400 N x 3.7 m
= 1480 J

and energy converted per second = $\frac{1480\ \text{J}}{14\ \text{s}}$

≏ 100 J per s

As about four such loads could be lifted in 1 minute of useful work, the cost of the energy is 1¢ per minute's work, or ¼¢ per load or

$$\frac{1}{1500}\ ¢ \text{ per joule.}$$

Deal with the cost calculations lightly, and do not ask pupils to copy those down, as we really want them to concentrate on the energy converted per second.

Ask a second pupil to demonstrate that he would be better value as a workman, time him, and so calculate his rate of converting energy. (No more cost calculations unless pupils are really interested.) Repeat with as many pupils as you like.

2 Explain that there is a special word *used* for the rate at which energy is converted; power. When we talk about power in science and engineering (as distinct from politics) we mean the rate at which energy is converted, that is, how many joules of energy are converted from one form into another per second. In the exercises which have been completed we could say that a certain pupil's power was 100 joules per second; another pupil with a power of 120 joules per second would be more powerful.

3 Because power is a very important quantity, and one that we come across all the time in everyday life, we have a special unit for it, and instead of writing down joules per second, we simply use the word watt.

1 watt = 1 joule per second

The class should record in their notebooks something like this: 'Power is measured in watts, and tells us how many joules of energy are converted from one form to another in 1 second.

1 watt = 1 joule per second

1 kilowatt = 1000 watts = 1000 joules per second'

They can then add a verbal description of the exercise they carried out in lifting the load for a measured time, finishing off the calculation:

'My power was 120 watts' or '. . . . . 's power was 90 watts'

APPENDIX FOUR

Tables of Results

TABLE 3

Results of ESP Criterion Sampling Test

Teacher	Skill Number 1	2	3	4	5	6	Total
1	64	85	93	52	50	50	394
2	43	88	53	76	50	100	410
3	58	88	100	52	50	100	448
4	56	85	67	80	25	100	413
5	63	87	100	60	100	100	510
6	63	83	87	68	50	100	451
7	70	96	100	76	100	100	542
8	73	78	100	80	100	50	481
9	43	80	93	76	100	100	492
10	55	79	100	76	100	100	510
11	43	61	90	68	50	25	337
12	49	76	-	-	-	-	-
13	64	84	93	72	50	100	463
14	61	95	97	72	100	100	525
15	55	90	100	80	50	100	475
16	60	80	97	52	25	100	414
17	51	66	100	76	100	100	493
Minimal Competence	55	53	50	48	50	50	306
High Competence	85	85	93	76	75	100	514

TABLE 4 Headteachers' Comments on ESP Teachers' Teaching Performance

Teacher's Rank on CSA test	Preparation of work	Content confidence	Attitude to teaching higher forms	Class control
1	prepares well in advance	confident	prefers higher forms	good
2	good	confident to 4th form	teaches 5th form	good
3	prepares well	very confident	teaches only higher	good
4	good	very confident	happy to	good
5	fair	good	would if asked	some concern
6	very conscientious	very confident	teaches mostly higher	good
7	good	knows his subject	likes to	good
8	prepares well	good up to 4th form	slight reluctance	good
9	very good	confident	happy with them	very good
10	not consistent	knows content	willing	needs improvement
11	good	good	good	good
12	O.K.	confident	happy teaching them	a little problem
13	prepares well	good up to 4th	hesitant about 5th	very good
14	needs more	good up to 5th	enjoys higher forms	problem
15	thorough	has increased	a little afraid	a little problem

TABLE 5

CSA and Headteachers' Assessments of ESP Teachers' Subject Knowledge

CSA SCORE (Skill 1 + 2)	TEACHES GCE CLASS
166	yes
156	yes
151	yes
150	yes
149	yes
148	yes
146	yes
146	yes
141	yes
134	yes
131	yes
125	no
123	no
117	no
104	no

r_{pbi} = 0.8 $p < .001$

2.3.3 Evaluation of Distance Teaching: A Criterion Sampling Approach

M Brophy and B A C Dudley
University of Keele

Abstract: The authors have been involved in an evaluation of an Emergency Science Programme (ESP), a distance teaching scheme for the in-service training of science teachers in Guyana. The study has been undertaken in collaboration with the UNESCO Institute for Education and forms part of the project 'The Evaluation of Learning in Non-Formal Educational Settings'. A number of evaluation methods have been used, of which one is the Criterion Sampling Approach (CSA). This approach involves the systematic observation, measurement, and evaluation of students' performances on standardized samples of the tasks for which they are being trained.

In the paper, the Criterion Sampling Approach to evaluation is outlined and its merits, in relation to other methods of evaluating distance teaching, discussed. An outline of the ESP programme in Guyana is given, with an account of how a CSA approach was developed for evaluating this particular project and how the results obtained by the CSA approach compare with those obtained using other evaluation techniques.

The Emergency Science Programme

In 1976, the Science Unit of the Ministry of Education in Guyana was asked to set up a training programme to help overcome the drastic shortage of science teachers in the secondary and community high schools of Guyana. As a result, the Emergency Science Programme (ESP) was launched in 1977. This in-service science teacher education project uses a three-way distance approach; the students receive correspondence units, tapes and slides, and they attend weekly tutorial sessions and annual vacation workshops (Brophy and Dalgety, 1980). The correspondence units are prepared by local lecturers, mostly from the University of Guyana, and the regional tutorial centres are staffed, on a part-time basis, by trained graduate science teachers. In the third long vacation the students are attached for a period of work study to a local industrial or medical laboratory.

Guyana is a relatively small country with a population of only 700,000, and although almost half of the science teachers are untrained there is a need for only a small number of trained science teachers. To date, approximately 60 teachers have been recruited to follow the ESP three-year training programme. The first batch began in 1977, the second in 1978, and a third intake are currently being recruited. Twenty-nine of the 1977 intake have successfully completed training and have been awarded trained teachers' certificates which are equivalent to those awarded to students from the college of secondary education.

It is appropriate now to carry out an evaluation of the ESP programme, an evaluation which is summative in that it assesses the degree of success the programme has in training the first batch of students and formative in that it provides information on which to base improvements for future generations of students.

Many distance teaching programmes have been set up, yet we can offer little substantial evidence to show that they produce the intended results. From over 60 projects using distance teaching methods to train teachers (Brophy and Dudley, 1980) we have little more than 'circumstantial' and 'anecdotal' evidence with which we can assess them (Jenkins, 1980). A thorough evaluation of a project such as ESP would, therefore, be of benefit for those who are considering the setting up of new projects and for those who are considering modifying existing ones.

The Evaluation Strategy

The evaluation of ESP is being carried out using a number of different approaches including:

1. A comparison of the performance of ESP 'graduates' with that of college-trained science teachers 'graduating' the same year. Points for comparison are self-image, final teaching assessment grades, ratings by headteachers and teaching style as perceived by pupils.
2. A comparison of the economic cost of training ESP teachers with that of training college science teachers.
3. An evaluation of the on-the-job performance of a sample of ESP teachers using a criterion sampling technique.

One aspect of this evaluation, namely the criterion sampling technique, will receive particular attention in this paper.

Criterion Sampling

Two major characteristics of a criterion sampling approach (CSA) to evaluation can be deduced from its title. First, it is dependent upon criterion referenced measurement. Unlike traditional tests which use norm referencing, criterion tests assess a candidate's performance against a fixed standard and they do not judge it in relation to the performance of others. If a candidate achieves a score above the fixed, 'criterion' standard he 'passes' – irrespective of the supply and the demand for people with this 'pass' qualification. In these respects criterion reference testing involves 'quota free' selection (Hambleton and Noviack, 1973).

In traditional pencil and paper tests students gain marks by responding to stimuli which they are unlikely to encounter outside the examination hall. Pencil and paper tests require indirect, 'symbolic' responses from their candidates, responses which may have little to do with the individual's actual behaviour in the job situation. In a review of 50 years of research on general intelligence tests, Ghiselli (1966) found that the correlation between these tests and job proficiency was no more than +0.23. In a CSA evaluation, an individual is assessed by the score he achieves on a number of situational 'performance' tests, tests which reflect the real life situation.

A second traditional method of evaluation, with which most of us in teaching are familiar, depends upon the candidate being rated by his supervisor on his job performance. For example, student teachers are assessed or rated by their lecturers on their ability to teach during teaching practice. This method has the advantage of allowing assessment to take place in the job situation but has the disadvantage that it is based on unstable – high inference – observation. Supervisors' ratings can be affected by many different uncontrolled factors. The second characteristic of the CSA approach is that it can control many of the variables encountered in the real-life situation by testing the candidate's performance on a sample of the tasks he would carry out in the everyday situation. CSA, therefore, attempts to standardize the test conditions while also approaching the authenticity of real life (Fredenkens, 1975). CSA has been described as an approach: 'in which the students' performance on standardized samples of tasks for which he has been trained is systematically observed, measured and evaluated'.

The CSA approach to evaluation is at present being investigated by the UNESCO Institute for Education, Hamburg, to see if it offers a suitable method for evaluating non-formal educational programmes. Distance teaching is one type of non-formal educational programme. At the request of the UNESCO Institute, a CSA evaluation was included with the other approaches being used in the evaluation of the Emergency Science Programme. This now forms one of four case studies which

are to be used for the Institute's meta evaluation, ie the evaluation of CSA as an evaluation method.

The CSA Evaluation of ESP

In a CSA evaluation the first step is for the evaluator to identify the major goals of the project under review. For ESP this was relatively simple because the goals had been written into the original proposal for the programme as submitted to the Board of Examiners in Guyana. Its major goals can be summarized as aiming to:

> provide its students with enough theoretical and practical knowledge in science, education, earth science, English and mathematics to enable them to teach the West Indian Science Curriculum (WISC) and the community high school science programme, Secondary Departments Science Programme (SDSP).

So ESP was designed specifically to train people to teach WISC and SDSP.

The second step in the CSA approach is to determine the criteria to be used to evaluate whether or not this goal has been achieved. A CSA approach requires that we use measures of candidates' performance on a sample of the tasks for which they have been trained. The ESP evaluation required, therefore, that we determine what a teacher must be able to do to teach WISC and SDSP by answering the question: 'What are the criteria by which we judge successful science teaching in Guyana?' The answer was determined by means of a two-stage strategy. The first stage involved a thorough review of the literature to determine what competencies science teachers and science educators thought were important for science teaching. Nine such competencies were identified. A further study of the literature was then made to determine which skills were required for each competency. Eighty-eight such skills were identified. The second stage involved asking science educators in Guyana which of the nine competencies they considered to be most important for teaching science in Guyanese schools and which of the 88 skills were most important for each of the competencies they chose as being important. In this way we were able to identify both the skills and the competencies that Guyanese science educators feel to be among the most important for teaching science in Guyana.

Criterion sampling involves the sampling of the criterion behaviours for which the students have been trained. The UNESCO Institute for Education recommend that the evaluator draws up a Task by Skill matrix in which the rows represent the tasks and the columns the skills underlying the performance. This matrix can then provide the test plan from which the evaluator can draw a sample of the task skill combinations. Science teachers are required to perform an enormous range of tasks involving a great number of skills. A task by skill matrix for science teachers would contain a large number of task skill combinations, many of which would be of limited use in everyday teaching. The sampling method used for ESP, therefore, was a modification of that suggested by UNESCO. Instead of taking a random sample from the universal set of task skill combinations, it was decided to use a stratified sampling procedure. The three competencies which were rated by the Guyanese educators as being the most important were isolated. The skills rated by the educators as being most important for each of these three competencies were then listed and a random sample drawn of two skills from each of the three lists. In this way a random sample was obtained of the skills which Guyanese science educators feel are the most important for teaching science in Guyana. The six skills identified in this way were:

1. Observe safety precautions for any situation that is likely to arise in his or her teaching.
2. Use correctly all the different apparatus and materials needed for the science curriculum being used by his or her classes.
3. Guide pupils to make conclusions from their observations.

4. Encourage pupils to record what they have observed.
5. Relate new experiences to pupils' previous experience.
6. Adapt a lesson plan to suit the specific local conditions of a school.

Both the WISC and the SDSP programmes have prepared detailed teachers' guides and an analysis of these was made to identify those tasks in which these six skills were necessary. Situational tests were then designed which would test the teacher's ability to perform these tasks. Where appropriate, random selections were made of the content to be tested. For example, one of the tasks a teacher would have to perform in order to use science equipment correctly (skill 2) would be to identify the equipment. A list of the equipment needed to teach WISC and SDSP was drawn up and a random selection made of 31 of the items, a 30 per cent sample. As part of the situational test for this skill, teachers were asked to identify this sample of WISC/SDSP equipment.

The situational tests were carried out in Guyana over a three-day period in January involving 16 of the 29 ESP teachers. Criterion performance levels for each skill were determined using 'inspection-based' and consensus judgements carried out by a panel of three representatives of the Guyanese science educators.

Results

Data from the CSA evaluation is still being analyzed but some findings are already clear, for instance 11 of the 16 teachers tested had at least minimal competence in all the six skills tested, four were competent in five of the six, and one was competent in four.

Level of Competence	*Criterion Skill*					
	1	*2*	*3*	*4*	*5*	*6*
High competence	0	6	12	8	7	13
Minimal competence	13	10	4	8	7	2
Below minimal competence	3	0	0	0	2	1

Table 1a. *Competence of ESP teachers on criterion skills*

	Number of Skills						
	6	*5*	*4*	*3*	*2*	*1*	*0*
High competence	0	1	6	3	3	2	1
Minimal competence	11	4	1	0	0	0	0
Below minimal competence	0	0	0	0	1	4	—

Table 1b. *Number of criterion skills in which ESP teachers were competent*

As mentioned earlier, the whole study has a dual purpose — one to evaluate ESP itself, the other to investigate how effective are the CSA tests at evaluating ESP. Correlations between CSA scores and final teaching assessments were low with the only correlation above +0.1 being that between teachers' assessment grade and score on skill 1 — knowledge of safety precautions ($p = 0.37$). A stronger relationship might be expected between the CSA scores on the two skills related to subject knowledge and the teacher's performance on the final science examination. There was, in fact, a significant positive correlation between skill 1 scores and science examination scores ($r = 0.6$ $p < 0.01$). The correlation with skill 2 — use of apparatus — was not significant at the five per cent level ($r = 0.26$). McClelland (1973), however, has argued that the criteria for establishing the validity of criterion referenced tests 'really ought to be not grades in schools, but "grades in life" in the broadest theoretical and practical sense'.

* Results based on preliminary data.

Accordingly the question that arises is how 'grades in life' for Guyanese science teachers can be assessed. In Guyana, as in many developing countries, headteachers tend to give the higher ability classes to the teachers in which they have the most confidence – especially with regard to their academic and subject knowledge. In Guyanese schools, a good measure of the headteacher's confidence in a teacher's subject knowledge would be whether or not he timetables that teacher to take a GCE class. Notes made of interviews with 15 of the ESP teachers' headteachers showed that 10 of the 15 taught GCE science and five taught only junior forms. In a comparison of the CSA results of the 'GCE' teachers with those of the 'non-GCE' teachers on skills 1 and 2 – those skills which related to subject knowledge – we find there is strong evidence to show that the scores of the teachers obtained via the CSA tests were consistent measures of their subject knowledge as perceived by their headteachers.

Teaches GCE	*Skill 1*	*Skill 2*
+	73	78
+	70	96
+	64	85
+	64	84
+	63	87
+	63	83
+	61	95
+	58	88
+	56	85
+	55	79
–	51	66
–	49	75
–	43	80
–	43	61
–	43	43

Correlation between skill 1 score and GCE teaching
$r = 0.83$ ($p < .001$)

Correlation between skill 2 score and GCE teaching
$r = 0.58$ ($p < .05$)

Table 2. *CSA scores of GCE and non-GCE teachers*

It might well appear that all we have to do to evaluate the teachers is to ask for the headteacher's opinion. However, our results show that while a headteacher's opinion correlates highly with a teacher's subject knowledge, it does not correlate at all highly with any of the other skills. So while headteachers may be choosing the most knowledgeable teacher they may not necessarily be choosing the best science teacher.

The evidence, so far, confirms that CSA testing is both feasible and suitable for evaluating distance teaching. Situational tests can be constructed to sample job tasks that the 'graduates' of distance teaching programmes are required to perform, and such tests can be accurate measures of on-the-job performance. This is not to say, however, that the CSA approach is a panacea for all problems encountered in evaluating distance teaching. Indeed, the ESP evaluation has identified a number of difficulties still to be overcome.

* Results based on preliminary data.

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2.3.4 Evaluating the Effectiveness of Distance Learning: A Case Study

E Scanlon
The Open University

Abstract: This paper will describe (i) the formative evaluation methods used to produce a revised version of the Science Foundation Course, (ii) the summative evaluation methods used to assess whether the revised version was an improved version, (iii) the extent to which the revised version was an improved version, and (iv) the extent to which the formative evaluation strategies used contributed to the improvement.

Introduction

Unlike teachers in traditional universities, Open University (OU) teachers receive no direct feedback from students. In most institutions, a great deal of feedback in courses is said to emerge informally and automatically from close interaction between students and teachers. More formal methods of evaluation have therefore been given careful consideration at the OU. The University is engaged in a cycle of remaking courses and a variety of models of using feedback in the production of these courses have been tested (Nathenson *et al*, 1981).

This paper examines the evaluation history of the Science Foundation Course over 10 years. This demonstrates how feedback data can be used in the attempt to improve courses. Also, by considering the successes and failures of the remade version of the course, the contributions of the evaluation strategies to the improvements will be identified. The main conclusion is that, while the course team was able to respond collectively to large structural and content changes in the material, individual course team members did not respond appropriately in all cases to detailed feedback which dealt with individual components of the course.

Patterns of Distance Teaching in Teacher Education

M. Brophy and B. Dudley
Education Department
Keele University

As school involvement ratios increase in developing countries and the numbers of school pupils correspondingly escalate the need for trained teachers will continue to grow. Traditional training programmes have failed to meet the demand in the past and are unlikely to meet future needs. A partial solution, as many countries have discovered, is to use diatnce teaching to train teachers. This can be done for a number of different purposes within teacher education, however, and different methods or approaches can be used. This paper analyses these different purposes and methods and suggests a means of classifying distance teaching approaches to teacher education.

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Patterns of Distance Teaching in Teacher Education

In many developing countries teacher training institutions have been unable to keep pace with the demands of their rapidly expanding education systems. Faced with the difficult choice between reducing the level of school enrolment on the one hand and employing untrained teachers on the other, governments have reluctantly inclined towards the view that, "poor education is better than no education" (Curle 1973) and have recruited unqualified staff to teach in schools. Indeed the education systems of many developing countries have been able to expand only by recruiting untrained teachers in large numbers. In India, for instance, more than half the primary school teachers and ninety per cent of the middle school teachers are unqualified (Jain 1977) and in Africa, Asia, South America and the Caribbean large numbers of untrained primary school teachers have been reported during the past five years (Wali and Lovegrove 1978, Young et al 1980 and Murray 1979).

While there may be debate as to whether or not teacher training colleges are viable in developing countries (Husen 1979 and Hawkridge et al 1978) there can be no doubt that they have failed to supply trained teachers in the numbers needed. In an effort to overcome their teacher shortage many developing nations have re-examined their conventional patterns of teacher education and sought to supplement them by introducing in-service teacher training programmes, for example with sandwich programmes in Brazil (Krasilchik 1980) and Nigeria (Hawes and Ozigi 1975) and evening classes in Guyana (Ministry of Education,Guyana 1977). Of all the strategies that have been tried,however, that of distance teaching is the most common. It has been used in over forty nations to supplement college-based training. It has many advantages and has met with considerable success.

Advantages of Distance Teaching for Teacher Education

For college-based training, teachers have to be removed from their schools; this exacerabates the already critical problem of teacher shortage and stand-ins, when available, are even less qualified than those they are

replacing. With a distance teaching method of training, teachers remain at their posts and replacements are not needed. Hanson (1969) in his report on staffing requirements for education in Africa, noted that,

> "the problems of staffing teacher's colleges seemed to be even more critical than those for secondary schools".

Distance teaching programmes have the advantage that they can pay specialists employed in universities and colleges, to prepare course materials. Similarly, while it is difficult for overseas specialists to participate for the two or three years of a college programme, it is comparatively easy to obtain their participation for short periods of time at summer institutes and vacation workshops and these can be incorporated into distance teaching schemes. With care, distance teaching schemes can be made to rely upon existing buildings, equipment and manpower and can be very economic. According to Lyle (1967) the UNRWA / UNESCO Institute of Education programme trained Palestinian teachers by correspondence (1964 - 66) at a cost of 341 US Dollars per student year, while similiar college-based training cost 820 US Dollars per student year. Kaunda (1973) found that correspondence courses run by the University of Zambia trained teachers for half the cost of full-time college trained teachers. Training teachers by distance teaching methods is less expensive than training them through college-based programmes.

Teacher training colleges are expensive to set up and difficult to staff. There can also be delays in completing college buildings such that it may take five years or more before their first trainees are available for teaching (Brophy and Dalgety 1980). Distance teaching programmes,however, do not necessarily need new buildings, they require minimal new staff and the teachers are immediately available to schools (though initially they are untrained). Since it is egalitarian rather than elitist in nature,distance teaching is expedient for most countries. Large numbers of teachers can be trained at any one time, and the programme brought to the teachers where they live; there need be no discrimination against those living in remore and rural areas. In Guyana, for instance, through distance teaching, qualified science teachers became available in regions which previously had been dependent upon either unqualified or expatriate teachers (ibid).

Curle (1973) suggests that creating alternative routes to advanced education will also help break down the elitism which has arisen in many new countries

from the limited number of places available in universities and colleges.

Training teachers in situ helps overcome problems encountered when trainees from rural areas are brought to towns or cities for college-based training. Often these rural students have difficulty settling into their courses and many of those who do settle do not want to return to their own areas after qualifying. Just such a problem has occured in the USSR; of those graduating from teacher training institutes in 1979, 38 % refused to take up posts as teachers, particularly when these were in village schools (Binyon 1980).

The fact that an in-service programme exists, with its correspondence materials and perhaps its radio and television programmes being distributed throughout a country has brought benefits to education systems in general and, in some cases, to the society itself. Kabwasa and Kaunda (1973) report that the radio programmes broadcast for the 8,335 students of a Kenyian distance teaching project were listened to by half a million adults, and Moss (1974) estimated that 46 % of all university tutors in England had used Open University materials in their conventional university programmes.

From the student teachers point of view it is a major advantage of distance teaching that they can become qualified without having to interupt their earnings. Many adults, especially those who are married, need to remain in their own town or village and it is important that they are not obliged to take up residence in, or near to, a college in order to be trained. Distance teaching methods allow the trainees a considerable degree of autonomy in developing their study habits and in setting the pace of their study. Both features are particularly advantagious in developing countries, for many of the male teachers also farm and a large proportion of the female teachers have young children. Teachers lviing in rural areas seldom have access to libraries, and distance teaching offers the further advantage that the structured correspondence units supplied to trainees will in themselves be a valuable source of reference materials, both for their training and for their teaching. Unlike college trained teachers, they do not have to return books when their training programme is completed.

Patterns of Distance Teaching

Distance teaching programme for teacher education are to be found in many different forms and they have served many different purposes. Some have been used solely to increase the teacher's academic knowledge. One, the Kenyian Junior Certificate Programme which began in 1967, provides a secondary education for teachers who have only a primary school education (Kinyanjui 1974). Another, the General Secondary Course, set up in 1965 by the Malawi Correspondence College provided secondary education for many uncertificated primary teachers (Ewing 1966). Where teachers have already achieved a satisfactory level of academic attainment, distance teaching has been used to provide professional knowledge and training. Graduates in Australia may obtain postgraduate teaching certificates through the correspondence courses of one of a number of universities (ibid and Smith 1978), and correspondence courses on teaching methods have been provided by the University of the West Indies for teachers on various Caribbean islands (Ewing 1966). On the other hand, there are some distance teaching programmes in which both academic and professional knowledge are supplied, either as part of an initial training scheme or as an aid to the understanding and teaching of a new subject or topic area. This is the way modern mathematics has been introduced into schools in Mauritus (Kinyanjui 1974) and science into basic schools in Chile (Martin 1980). Teacher training courses which provide all the academic and professional knowledge and training needed to obtain certification have also been developed using distance teaching techniques. Some of the better known programmes of this type are the UNRWA / UNESCO Institute of Education Project for Palestinian teachers, which has been in operation in the Arab refugee camps in Lebanon, Gaza, Jordon and Syria since 1964 (Kinyanjui 1974) and the Francistown Teacher Training Project which, between 1968 and 1973, trained over 80 % of the unqualified primary school teachers in Botswana (ibid, and Kabwasa and Kaunda 1973).

As well as serving different purposes, the programmes for teacher education have employed a variety of distance teaching approaches. Some, such as the schemes in Burma, Dahomey and the West Indies (Ministry of Education,Burna 1979, Kabwasa and Kaunda 1973 and Ewing 1966) have relied upon written correspondence materials alone while others use written correspondence linked with media materials. The National Teacher's Institute in Kaduna,

Nigeria, uses written materials and audio cassettes (Wali and Lovegrove 1978) while the Television University of China, as its name implies, uses television broadcasts and correspondence materials (McCormick 1979)
A third approach, which, like the first, does not use media at all, relies upon supplementing the correspondence materials with face-to-face tutorial sessions and is found in Jamaica (Murray 1979) and Zambia (Kabwasa and Kaunda 1973). From 1968 to 1979 it was also used for the Proyecto de Perfeccion-amiento en Servico (PPS) by the Ministry of Education in Chile (Martin 1980). But each of these three approaches is less common than the one in which all three means of communication, namely correspondence, media and face-to-face meetings are employed. This three way approach, best known through its use in "Open" university schemes, has also been used specifically for teacher education in Kenya, Ivory Coast, Algeria, Botswana, Guyana, Uganda, Nigeria, Sri Lanka and Swaziland (See Young et al 1980, Brophy and Dalgety 1980, Kabwasa and Kaunda 1973 and Kinyanjui 1974).

Distance teaching schemes have been designed to serve a number of purposes and have employed a range of methods. There is such a variety that it is difficult to establish the relative merits of each. A classification of distance teaching patterns, both past and present, used for teacher education would help and such a classification is presented in Table 1. It is a grid or matrix, in which each teacher education programme is classified into a column according to its main purposes, and into a row according to its methods of communication with participants. A survey of distance teaching programmes for teacher education shows that all of them can be classified into this four by four grid.

There are four groupings with regard to purposes, namely

1 academic content alone,

2 pedagogy alone,

3 a limited amount of both content and pedagogy (limited in that a complete training programme for certification is not offered)

4 a complete training programme of both content and pedagogy (offering certification to those who complete the work successfully).

In much the same fashion these programmes can be separated into four groups with regard to the method, or methods, employed by each, namely

TABLF 1 *A Classification of Distance Teaching Projects for Teacher Education*

	Academic Alone (1)	Pedagogy Alone (2)	Limited Academic with Pedagogy (3)	Complete Academic with Pedagogy (4)
Correspondence Alone (a)	British Honduras Congo Zambia (1)	Malaysia Australia (1) West Indies	Australia (5) W. Germany (2) South Pacific	Algeria New Zealand (2) Dahomey Chad Burma Peru Nigeria (2)
Correspondence and Media (b)	Malawi China	Australia (2) Zambia	Mauritus	Nigeria (3)
Correspondence and Face-to-face (c)	Zambia (2) Ghana	New Zealand	Chile St Lucia Togo	Dominica Nigeria (4) Jamaica
Correspondence and Face-to-face and Media (d)	Sri Lanka (1) Kenya (1) UK (1)	UK (2) Nigeria (1) W.Germany (1) Australia (3) Australia (4) Costa Rica Pakistan Sri Lanka (2)	Philippines UK (3) Niger Ivory Coast Spain Tanzania (1) Israel Mexico	Botswana Kenya (2) Sri Lanka (3) Lebanon Iran Venezuela Nigeria (5) Uganda Mali Guyana Colombia Lesotho Swaziland Tanzania (2)

a correspondence materials alone,
b correspondence materials and media,
c correspondence and face-to-face, and
d the three way method (of correspondence,media and face-to-face).

All sixteen different distance teaching patterns identified by this four by four matrix have been used in teacher education. The programmes in Table 1 include distance teaching schemes designed specifically for the training of teachers and also schemes intended for a wider audience, but in which teachers are known to make up 30 % or more of the student body.

The classification shows a number of trends in distance teaching. Most complete training programmes (Column 4 in Table 1) have been designed for primary school teachers and few projects rely solely on written correspondence materials (Row a). Of the distance teaching projects which encountered difficulties in implementation many had tried to rely on correspondence alone. The University of Brazzaville programme (Cell 1a) suffered a high drop out of students, the programmes of the Institut Pedagogique National in Dahomey (Cell 4a) encountered administrative problems and the Malaysian Teacher Education project (Cell 2a) was judged by the Ministry of Education to be unsatisfactory and was terminated. Other projects, that were of the correspondence alone type, have been modified; the Ministry of Education in Burma (Cell 4a) now includes the use of audio cassettes and so becomes a 4b project, the Diploma in Education in the South Pacific, initially a 3a has become a 3b project and the CNEG programme in Algeria (Cell 4a) now includes both media and face-to-face sessions (Cell 4d). In each case the modifications lead to the programmes being reclassified lower in the tabel rather than across; the purposes remain constant (the Columns) but the means to achieve them (the Rows) changed.

In spite of (or perhaps because of) the economic depression which has hindered development in many third world countries during the past decade distance teaching is likely to play an increasingly important role in teacher education in developing countries for the foreseable future. Over sixty such projects have been developed to date. For anyone wishing to develop a new project or modify an existing one it is important, therefore, that they should be able to critically analyses previous programmes and where possible learn from their experience. It is hope that the matrix presented here will assist such analyses.

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A directory of the programme listed in Table 1 is available from the authors.

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DISTANCE-TEACHING SCHEMES FOR TRAINING SMALL NUMBERS OF TEACHERS

M. Brophy and B. Dudley, Department of Education, University of Keele, England

While it is true that distance-teaching projects become relatively cheaper as the number of students using the programme increases[1], it is also true that distance teaching can be viable for teacher-training projects which involve small numbers.

There are such urgent needs in third world countries for specialist science, mathematics, and industrial arts (craft) teachers that these needs cannot be met either through normal college-based training programmes or by large scale in-service projects. They have been, and continue to be, met by distance teaching schemes, as was the case in Guyana in recent years.

In September 1976 the government of Guyana took control of all schools in the country and found that many of the people teaching science in the secondary schools were untrained and had only GCE 'O' level qualifications. (This was the UK-based General Certificate of Education, normally obtained after five years of secondary school education.) At that time the old college of education building had no functional laboratories and the planned new college of education would not be opened for at least another five years. Few students were taking the science programme in the college and there were neither staff nor facilities to cope with any substantial increase in their numbers. The Ministry of Education, therefore, was faced with the problem of having no institution available in which these existing secondary school science teachers could be trained. At the same time, the Ministry was pressing ahead with its plans to convert many of the 'all age' sections of the primary schools (which catered for approximately 70% of the 11 to 15 age group) into community high schools. Science would feature prominantly in the curriculum of these new community schools; in the 'all age' schools, little if any work was being done in science. The shortage of science teachers was becoming critical.

To help overcome this shortage the Science Unit of the Ministry of Education planned an in-service training project for science teachers - the Emergency Science Programme (ESP) - which began in April 1977. This programme uses a three way distance-teaching approach and includes correspondence units, weekly face-to-face tutorial sessions and vacation workshops, as well as audio-visual tapes and slides. In 1977, 46 students, who were already teaching in secondary schools, were recruited for the programme. They were working in all regions of the country, including the remote, isolated, north-west and Kwakwani areas. In 1978 a further 22 students began training, selected this time from community high schools.

The trainees have a minimum of four GCE 'O' level passes (Grades A, B or C) with at least one of these in a science subject. Before entry to the programme each student had taught for about two and a half years. Experienced educators, from the University of Guyana and from the various sections of the Ministry of Education, were commissioned to prepare the correspondence materials. Local trained graduate science teachers were appointed as part-time tutors, and tutorial centres were set up in five regions of the country. Over the three-year training period students receive 18 correspondence units, each of which is expected to provide them with 78 hours of study, including 18 hours work at the local tutorial centre, where emphasis is placed on laboratory and group learning methods. In the first and second year of training additional practical work is undertaken at the three-week workshops held during the long vacations. In the third long vacation the students are attached for a two to three-week period to a local industrial or medical laboratory. For example, in 1979, students were attached to the Government Analyst Department, the Meteorology Office, hospital laboratories and private food company laboratories. There the students were trained to use the apparatus and carry out many of the experiments normally undertaken in those laboratories.

The 1977 intake of students have now (1980) completed the ESP programme and the 1978 intake are in their final year of training. In addition, the correspondence units are being used by science students in the Secondary College of Education, because all three science tutors in the college have gone overseas for further training. The college was able to carry on its own science programme by means of the correspondence materials of the ESP programme and with the help of part-time staff.

There were only 162 untrained non-graduate science teachers in Guyana in 1977, yet this represented almost half of the science teachers in the country[2]. Any programme that intended to help these people was of necessity bound to involve a small number of students. They were in all regions of the country and many of them were in isolated rural areas. It would have taken very many years to resolve the shortage of trained science teachers using the college-based approach, and in the meantime schools would still have been staffed with untrained, underqualified teachers. The further expansion in science teaching would have been greatly constrained. Distance-teaching methods offered a viable supplement to traditional training programmes, helping to alleviate the problem immeidately and resolving it in time. The ESP distance-teaching programme appears to have met with considerable success. However, Michael Brophy is presently undertaking a summative evaluation of the ESP project with a view to providing evidence on how well, in fact, the programme has achieved the objectives set for it by the Ministry of Education in Guyana. One part of the evaluation involves using a criterion-sampling approach (CSA) and this will form a case study for the Unesco Institute for Education project 'The Evaluation of Learning in Non-formal Educational Settings', the results of which should be valuable to others interested in evaluating distance-teaching approaches to teacher training.

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Appendix 4

Distance Teaching Programmes for Teacher Education, Proposal for The Emergency Science Programme and Extract from the Government of Guyana Official Gazette.

Distance Teaching Projects Listed in Table 1

Algeria

The Centre National d' Enseignement Généralisé (CNEG) initially correspondonce courses alone to train primary school teachers but later supplemented by evening classes, seminars and broadcasts.

Cell 4a (later 4d) Kabwasa and Kaunda(1973) Kinyanjui (1974)

Australia

(1) Victoria Education Department provided correspondence courses for in-service training of already professionally qualified primary teachers.
Cell 2a Ewing (1966)

(2) Western Australia Institute of Technology offers distance teaching programmes leading to a masters degree and a diploma in science education.
Cell 2b Ref. Dekkers (1974)

(3) The University of New England offers masters degrees and diplomas in education using correspondence materials with media and vacation courses.
Cell 2d Ref Smith (1973)

(4) In 1978 Deakin University began open university type courses in education, humanities and social science.
Cell 2d Ref Jevons (1978)

(5) The In-service Training Branch of the Department of Education in New South Wales provided correspondence courses for the professional growth of trained teachers which also included some acadinic content in science and the humanities.
Cell 3a Ref Ewing (1966)

Botswana

The Francistown Teacher Training College project which ran from 1968 to 1973, trained about 600 unqualified primary school teachers using correspondence materials linked with residential courses and radio programmes.

Cell 4d Ref Young (1980), Kabwasa and Kaunda (1973) and Kinyanjui (1974)

Burma

The Ministry of Education in Burma in 1978 introduced a two year correspondence course for non-certificated teachers to help overcome what they referred to as ' a very acute shortage' of trained primary school teachers. They later supplemented the printed materials with audio cassettes.

Cell 4a Ref . Burma, Ministry of Education (1979)

British Honduras (Belize)

Correspondence courses for uncertificated teachers in English, History and Science arranged,in 1966, by the Roman Catholic Managing Authority. These courses were at two levels , the higher of which was intended to prepare teachers for entering training college.

Cell 1a Ref Ewing (1966)

Chad

Correspondence courses for teachers run by the Teacher Training Centre of the Ministry of Education.

Cell 4a Ref Kabwasa and Kaunda (1973)

Chile

The Proyecto de Perfeccionamiento en Servico was an in-service training project for grade 5 to 8 teachers which ran from 1968 to 1979 and used correspondence materials linked with face-to-face teaching

Cell 3c Ref Martin (1980) and Baez (1976)

China

The Television University of China began broadcasting in February 1979 and by the end of the year had 420,000 enrolled students, 30% of whom were middle school teachers.

Cell 1b Ref McCormick (1979)

Colombia

The University of Javeriana set up an open university type programme for rural primary school teachers to help overcome an urgent call for training. This programme uses correspondence materials with television broadcasts and some face-to-face teaching.

Cell 4d Ref Pena (1977)

Congo

The University of Brazzaville provides correspondence courses in History, Geography, Language and literature. 30% of the students are teachers.

Cell 1a Ref Kabwasa and Kaunda (1973)

Costa Rica

The Universidad Estatal a Distancia offers bachelor degrees in school administration and education as well as in-service training for secondary school Geography teachers.

Cell 2d Ref Pacheco (1978)

Dahomey

The Institut Pedagogique National offers correspondence lessons for monitors and teachers leading to the Certificate of Proficiency (CAM), the Elementary Certificate (CEAP) and the Teaching Proficiency Certificate (CAP).

Cell 4a Ref Kabwasa and Kaunda (1973)

Dominica

In 1966 the Education Department provided a training programme for uncertificated teachers using correspondence assignments and fortnightly training classes.

Cell 4c Ref Ewing (1966)

Ghana

The Correspondence Unit of the Institute of Adult Education at the University of Ghana offers a secondary education programme for adults using correspondence materials and face-to-face sessions. 33% of the students are teachers.

Cell 1c Ref Kabwasa and Kaunda (1973)

Guyana

In 1977 the Ministry of Education in Guyana began a three year in-service training programme for Science teachers using correspondence materials, weekly face-to-face sessions and audio cassettes.

Cell 4d Ref Brophy and Dalgety (1980)

Iran

The Free University of Iran, in 1978, began a programme to prepare Science and Mathematics teachers to initial degree level. The project uses correspondence materials and face-to-face teaching linked with television and radio boradcasts.

Cell 4d Ref Free University of Iran (1978)

Israel

Everyman's University provides in-service teacher training courses using correspondence materials, televsion and some face-to-face tuition.

Cell 3d Ref Young (1980) and Ginzberg (1978)

Ivory Coast

The Television and Educational Reform Project was set up to provide primary education for children, and in-service training for teachers. In 1977, 7400 teachers were receiving training through the project.

Cell 3d Ref Young (1980) and Kaye (1978)

Jamaica

The In-service Teacher Education Thrust (ISTET) is run by the Ministry of Education for teachers in primary and all- age schools. It is a four year part-time programme using correspondence materials linked with vacation and weekend workshops.

Cell 4c Ref Murray (1979)

Kenya

(1) The Junior Certificate programme of the Correspondence Unit of the University of Nairobi was set up in 1967 to provide untrained primary teachers with two years of secondary school education.

Cell 1d Ref Kabwasa and Kaunda (1973) & Kinyanjui (19

(2) The Unqualified Teachers programme of the same university started in 1969 using a three way approach to provide a complete training programme for primary school teachers.

Cell 4d Ref Kabwasa and Kaunda (1973)& Kinyanjui(1974)

Lebanon

The UNRWA / UNESCO Institute of Education project for Palestinian teachers, which begun in 1964 was in Lebanon, had teaching centres in Arab refugee camps in Gaza, Jordon and Syria.

Cell 4d Ref . Young (1980), Lyle (1967) and Kinyanjui (1974)

Lesotho

The Lesotho Distance Teaching Centre in conjunction with the National Teacher Training College began in 1978 a distance teaching programme for 400 unqualified teachers.

Cell 4d Ref Young (1980)

Malawi

The Correspondence College at the Further Education Centre in Blantyre,set up in 1964, offers secondary education courses for primary school leavers and also in-service training for primary teachers. Of the 1000 students enrolled in the secondary education rogramme in 1965, 30% were uncertificated primary school teachers.

Cell 1b Ref Young (1980), Kabwasa and Kaunda (1973) and Ewing (1966)

Malaysia

Correspondence courses in pedagogy were provided for uncertificated teachers by the Ministry of Educationin the early sixties . However the Ministry found the programme to be unsatisfactory and it was discontinued in 1966.

Cell 2a Ref Ewing (1966)

Mali

The Institut Pedagogique National de Mali provides teacher training courses using corres ondence materials linked with radio braodcasts and face-to-face seminars.

Cell 4d Ref Kabwasa and Kaunda (1973)

Mauritus

The Mauritus College of the Air Primary Mathematics roject, set up in 1972 to train the island's primary school teachers in the teaching of modern mathematics

originally used correspondence materials and radio broadcasts but later occasional face-to-face sessions were added.

Cell 3b Ref Kinyanjui (1974)

Mexico

The Telesecundaria Project was set up in 1966 to provide alternative secondary schools in rural areas. Each class of children has a primary school teacher who acts as a local co-ordinator and these teachers receive additional training through correspondence materials, television broadcasts and face-to-face sessions.

Cell 3d Ref Young (1980)

New Zealand

The Correspondence School of the Department of Education in New Zealand was established as early as 1922. In the early sixties it provided

(1) a Diploma in Teaching programme for trained teachers .Cell 2c, and

(2) a Technical Teacher's Certificate Cell 4a Ref(21) Ewing (1966)

Niger

In the Télé-Niger project young primary school leavers received a three week training course followed by correspondence materials and television broadcasts to enable them to act as teaching monitors in the primary schools using television teacning.

Cell 3d Ref Young (1980) and Kinyanjui (1974)

Nigeria

(1) A Postgraduate Diploma in Science Education offered by the Correspondence and Open studies Unit of the University of Lagos.

Cell 2d Ref University of Lagos (1976)

(2) Ministry of Education (Kaduna) correspondence programme for the Higher Elementary (Grade 2) Teacher's Certificate.

Cell 4a Ref Ewing (1966)

(3) Emergency Teacher Training Scheme, National Teacher's Institute.

Cell 4b Ref Wali and Lovegrove (1978)

(4) Teacher In-service Education Programme (TISEP), Institute of Education Ahmadu Bello University.

Cell 4c Ref and Kabwasa and Kaunda (1973) , Aleyideino and Hawes (1971)

(5) The Correspondence and Open Studies Unit of the University of Lagos offer a BSc in education by distance teaching.

Cell 4d Ref University of Lagos (1976)

Peru

Correspondence courses for in-service teacher training were set up in 1972 by the National Institute of Research and Development of Education (INIDE). Young reports that the programme was'beset' with difficulties.

Cell 4a Ref Young (1980)

Philippines

Primary school teachers involved in the Educational Radio Technical Assistance project receive limited training through correspondence materials,radioo lessons and occasional group meetings.

Cell 3d Ref Young (1980)

Pakistan

The Faculty of Occupational Education of the People's Open University is especially Concerned with teacher education and agricultural education. Khan reports that priority will be given in teacher edu cation to providing in-service training to practising teachers to 'improve their teaching skills by equipping them with up-to-date knowledge of child, adolescent and adult psychology, instructional techniques, guidance and counselling'.

Cell 2d Ref Khan (1974)

St Lucia

A correspondence course linked with face-to-face teaching sessions and organized by the Ministry of Education for uncertificated teachers. After the six years of part-time study trainees spent one year of full-time study at a teacher's training college in order to receive certification.

Cell 3c Ref Ewing (1966)

Spain

The Universidad Nacional de Educación a Distancia in Madrid provides an in-service diploma course for teachers in commerce schools.

Cell 3d Ref Lorente (1978)

South Pacific

In 1971 the University of the South Pacific in Fiji set up the Diploma in Education programme to provide academic knowledge and professional training for experienced but untrained teachers. Originally the programme was based on correspondence materials alone but later these were supplemented by audio cassettes. After completing the distance teaching component students spend their final year in full-time study at the University before qualifying for the Diploma.

Cell 3a Ref Kinyanjui (1974)

Sri Lanka

(1) The Sri Lanka Institute of Distance Education (SLIDE) set up in June 1976, offers courses leading to National Diplomas in Science and in Mathematics. They are teacher oriented and have been designed specifically to help overcome an acute shortage of science and mathematics teachers.

Cell 1d Ref Perera (1978)

(2) Correspondence Teacher Education Unit set up in 1972 to increase the rate at which the country's 40,000 untrained teachers were receiving in-service

training. Distance teaching courses are offered for untrained teachers, one for graduates (Cell 2d) and another for non-graduates (Cell 4d)

Ref Young (1980) and Kinyanjui (1974)

Swaziland

The William Pitcher Teacher Traing College in 1973 began a five year programme for 600 unqualified primary teachers using distance teaching techniques. It has now been extended to include a further 500 trainees.

Cell 4d Ref Young (1980)

Tanzania

(1) The National Correspondence Institution of the University of Dar-es-Salaam runs a distance teaching programme in political education for teachers.

Cell 3d Ref 18 Kabwasa and Kaunda (1973)

(2) The Institute of Adult Education Correspondence Education Department has been running distance teaching training programmes for primary teachers since 1976.

Cell 4d Ref Young (1980)

Togo

The Ecole Normal Superiere provides a distance teaching programme for the up grading of teaching assistants.

Cell 3c Ref Kabwasa and Kaunda (1973)

Uganda

The Correspondence Unit of the Centre for Continuing Education at the University of Makerere in 1967 began a distance teaching project for upgrading Vernacular teachers (those who teach in a local language), and a programme for Licensed teachers which began in 1971.

Cell 4d Ref Young (1980) and Kaye (1978)

United Kingdom

The Open University in England offers a number of courses, some of which are designed for teachers. In others, not intended specifically for them, teachers make up over 30% of the student body.

(1) Open University Degree programme following academic courses only. Cell 1d

(2) Open University Post Experiences courses. Cell 2d

(3) Open University Degree programme following both academic and education courses. Cell 3d

Ref Open University (1980)

Venezuela

The National Open University of Venezuela offers courses leading to education degrees with majors in Physics and Mathematics.

Cell 4d Ref Project (1979)

West Indies

The University of the West Indies provided correspondence courses in pedagogy for uncertificated teachers in a number of the Caribbean islands including the Virgin Islands, St Kitts, Nevis and Anguilla.

Cell 2a Ref Ewing (1966)

West Germany

(1) The Fernuniversitat in Hagen began distance teaching programmes in October 1975, providing courses in Mathematics, Economics and Education.

Cell 2d Ref Peteres (1978)

(2) The Deutsches Institut Für Fernstudien of the University of Tübingen provides in-service training for Biology, Chemistry and Physics teachers.

Cell 3a Ref Fernstudium Im Medienverbund (1978)

Zambia

(1) The Correspondence Unit of the Ministry of Education provided correspondence courses for the Junior Secondary Education Certificate (JSE) and for the General Certificate of Education (GCE). 54% of the students of theJSE programme were teachers as were 34% of those on the GCE programme. Cell 1a

(2) University of Zambia BSc degree programme aimed at existing teachers amongst others. Cell 1c

(3) University of Zambia scheme for training teachers in Educational studies

Cell 2b

Ref - Kabwasa and Kaunda (1973).

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Extract from the "Official Gazette" of Saturday, 10th January, 1981

VACANCY

MINISTRY OF EDUCATION, SOCIAL DEVELOPMENT AND CULTURE

Applications for the "EMERGENCY SCIENCE PROGRAMME" Teacher-Training Course, 1981 — 1984.

Applications are invited from suitably qualified teachers who are desirous of pursuing a course in in-service teacher-training for teaching Science in a Secondary (including Community High) School. The Emergency Science Programme Course leads to the award of a Trained Teachers Certificate (Science). Duration of the Course will be three (3) years.

Applicants must have minimum qualifications as follows :—

(a) FOUR (4) C XC, General Proficiency passes, Grades I or II, of which must be Integrated Science.

(b) FOUR (4) G.C.E., Ordinary Level subject passes, Grades A, B or C with effect from June 1975; one of which must be a Science subject,

OR

(c) Any combination of (a) and (b) above, provided one of the four subjects is a Science subject.

Applicants are asked to note that because of the standards set for the academic component of the training programme, the qualifications listed above are the minimum academic qualifications required. —

Applications are also invited from suitably qualified persons who are desirous of teaching.

COURSE CONTENT

1. The course consists of units in Science, Education, Foundation Mathematics, Foundation English and Geography for Scientists.

2. The training is effected through :—

(a) Correspondence material,

(b) Weekly Three-hour tutorials,

(c) Teacher Vacation Courses,

(d) Workshops,

(e) Supervision of classroom teaching,

(f) A work-study course, and

(g) A long-term, task-oriented project in Science or Science Education in the community; and the presentation of a dissertation related to the project.

CRITERIA for CERTIFICATION are :—

(1) Successful completion of the prescribed course of study, and a satisfactory level of participation and work, throughout the three year period, in assignments, tests and workshops.

(2) Success in the first, second and third year examinations.

(3) At least 75% attendance at the relevant vacation, work-study and tutorial courses.

On successful completion of training, graduating students will be employed as Grade I Trained Teachers on the salary scale E10 : i.e. $39.68 — $612.86 (revised 1980).

Successful applicants will be required to sign a bond to serve as a teacher in a Government School in any part of Guyana for a period of THREE (3) years immediately after completing the course; then the obligation shall be void; but otherwise shall remain in full force and effect.

Headmasters/Headmistresses are requested to ensure that this notice is brought to the attention of ALL untrained personnel on their staff.

Application Forms may be obtained from :—

1. The Student Affairs Division, Ministry of Education, Social Development and Culture, 21 Brickdam, Georgetown.

2. The District Education Officers at New Amsterdam, Fort Wellington, Vreed-en-Hoop, Linden, Suddie and Mabaruma.

3. The Education Officer (Science) Ministry of Education, Social Development and Culture, 68 Brickdam, Georgetown, or

4. The Secretary, Teacher Training Activities, c/o Flat 8, Queen's College Compound, Georgetown.

All applications should be sent to the Education Officer (Science) Ministry of Education, Social Development and Culture, 68 Brickdam, Georgetown; and should reach that office not later than Friday January 23, 1981.

M. T. Lowe,
Chief Education Officer.

(No. 35)

PROPOSED EMERGENCY PROGRAMME FOR THE UPGRADING OF JUNIOR SCIENCE TEACHERS IN SECONDARY AND COMMUNITY HIGH SCHOOLS.

The Shortage of Science Teachers and Its Effects

For many years now there has been an acute shortage of qualified science teachers in the secondary schools and with the opening of the Community High Schools this shortage will assume disastrous proportions. The effects of the absence of qualified teachers of science are clearly seen not only in the poor results of our children in G.C.E. science subjects, (such as those shown in Table 1 below), but also in the lack of trained personnel for science and technology. *

Table 1

Percentage of candidates in Guyana Secondary Schools passing O-level Science subjects in June 1974.

	Biology	Chemistry	Physics
Entered	2938	1134	1108
Passed	1057	494	434
Percentage	36	44	39

Ref. 1. (Derived from:- "A Digest of Educational Statistics" 1973 - 1974)

Thus one of the major findings of Dr. L. G. Ponnamperuma, the Special Adviser (Science), from the Commonwealth Fund for Technical Co-operation in his report, "Guyana the organisation of technological research and development" was that in Guyana, 'there is at present a dearth of Supporting Scientific and Technical Services and Research and Development to support various sectors of the economy'. (Ref. 2)

This 'dearth' was said by the marketing manager of the Guyana Timber Export Board in a memorandum to the NSRC to be due largely to a, "Lack of qualified scientific and technical personnel" and seen by him to be, 'a bottleneck to Guyana's rapid industrialization" (Ref. 3) He suggests that this man-power problem which is itself two fold due to:

(a) limited facilities and motivated students available for training,

(b) a shortage of qualified science teachers

Dr. J. Whitehead has stated, "The science and technical output of the educational system will not increase until more teachers with appropriate qualifications are available ....." (Ref. 10)

It is clear therefore that an adequate pool of skilled and trained scientific personnel can never be achieved while we are forced to use unskilled and untrained teachers of science. Unfortunately, this is what has been happening despite the efforts by the various training institutions to recruit student teachers of science. This is borne out both by a survey carried out in 1974 by Dr. Thollairathil at the University of Guyana and by the answers to a questionnaire sent out by the Ministry of Education to all secondary schools, in September of this year. See Table 2 and 3 below.

Table 2

Survey of Science Teachers in 40 secondary schools in Guyana 1974. (Adapted from survey by Dr. Thollairathil U.G.) Ref. 4

Trained Graduate	21	Percentage trained 32.6%
Untrained Graduate	32	Percentage untrained 67.4%
Trained Teacher	40	
A-Level untrained	58	
O-Level untrained	36	
Total	187	

Table 3

Response to Questionnaire returned by 31 secondary schools on Science Staffing 1976. Ref. 5

Trained Graduate	10	
Untrained Graduate	60	Percentage trained 14.8%
Trained Teacher	19	Percentage untrained 85.2%
A-Level untrained	63	
O-Level untrained	44	
Total	196	

There is every reason to believe that these schools are typical of the other 26 in the country. (A list of the 31 schools that have been included in this analysis is given in Appendix B). So in these 31 secondary schools today less than 15% of the teachers teaching science have had any teacher training. This as can be seen, is very much less than the 32.6% in the 1974 survey.

Using this list and informal contacts with the schools, to date 80 persons who are teaching with only O-level qualifications, have been identified in secondary and community high schools. This includes 12 of the 18 science teachers so far appointed to community high schools, some of whom have a pass in only one O-level science subject. However, even in the secondary schools the problem is more acute than Tables 2 and 3 suggest. For example of the 70 graduates in the 1976 survey, 36 (i.e. 51%) teach in only 5 of the 31 secondary schools. Some schools have <u>NO</u> trained science staff whatever. Thus one school with seven persons teaching science, have two with A-level and five with O-level, of these one person has A-level physics, one has A-level chemistry and no one has A-level biology. Another school has only one A-level and three O-level teachers. So it is clear therefore that the system has a large percentage of untrained, unskilled science teachers and that situation will get worse unless some specific action is taken to overcome it.

The urgent need to 'improve the quantity and quality of science teachers' was clearly recognized in the Group Report, Ref. 6., at the Diamond Workshop of the National Science Policy and Plan of Action For Guyana, and it was stated in this report that, 'Education and training was the prerequisite for the attainment of <u>all</u> the priority goals in any national science policy.....'

This workshop also suggested that, "The supply of scientific, engineering and technical manpower should be increased <u>as rapidly as</u> possible and used to its fullest extent in the interests of the Development Plan." Ref. 7 And to assist with this it proposed a 'crash programme' to increase this supply. But as Ponnamperuma suggests,

"Science at school level provides the input to higher educational and training institutions and hence in fact holds the key to the output of scientific and technological personnel."

With this comment in mind and taking into account NSRC's own proposal for a 'crash programme', it is obvious that there is need for the immediate implementation of an emergency programme to train science teachers, one which will make use of the availability of the many unqualified persons who are already acting temporarily as teachers of science in our secondary and community high schools.

Since those with A-levels nearly all leave the system within a couple of years, this programme is proposed to enable those persons with four or more O-levels who are already teaching science, to become trained qualified teachers after three years of in-service training. Otherwise, they too will leave in a short time.

Thus it will supplement the normal output of science teachers without disrupting the present system and so help to reduce the current shortage of science teachers.

The Programme, Aims and Methods

The programme will aim to:

1. provide the students with sufficient content knowledge in Integrated Science to enable them to teach the proposed CXC, WISC and Community High School Programme,

2. develop in the students a working knowledge, to A level standards, of those areas of chemistry, biology, physics and the earth sciences which will be necessary for an adequate understanding of the proposed CXC, WISC and Community High School Programmes,

3. provide a course of training in educational theory and practice which will enable the students to fulfill their role as qualified teachers in Secondary and Community High Schools,

4. expose the students to other fields of study relevant to the teaching of Integrated Science and the integration of science in the curriculum, and

5. foster in the students an awareness of the importance and relevance of science and technology to the achievement of the aims of a developing society.

It is proposed that the students will be time-tabled in their schools to have at least the equivalent of one day per week to devote entirely to the training programme. They will also be expected to follow study periods at home, in the tutorial groups and at Teacher Vacation Course Centres.

The programme content will be based on:- The College of Education Programme, the proposed CXC programme, WISC, the Community High School Programmes and A-level science courses.

It will use a variety of media and it is proposed to incorporate into it:-

(a) Correspondence material:

which will include reading material and practical investigations, to be carried out, written up and presented for assessment purposes.

(b) Tutorial Groups:

meeting regularly under a local experienced graduate teacher, for work related to the correspondence material. These will be held outside school hours, for example on a Saturday morning. (An analysis of the areas in which there are O-level people teaching suggests that there would need to be at least six tutorial groups; one in Georgetown, one on the East Coast, one in New Amsterdam, one in Rose Hall, one on the West Coast or West Bank Demerara and one in Essequibo.)

(c) Two, three week Vacation Courses designed especially for these students, to increase their number of contact hours with experienced science educators, equipment and fellow students.

(d) Two, one week periods of work experience during school vacation, working in local industries, such as mining, forestry or brewing.

(e) One long term task-oriented educational project and the presentation of a 5,000 word dissertation related to this.

In connection with the tutorial groups (b) Mr. D. Whitecross of the UK Ministry of Overseas Development has indicated that his ministry would be willing to finance the provision of a number of small libraries for these tutorial groups. Thus the six tutorial centres in the various areas would each have their own small library of relevant background books.

Teaching Standards

It is proposed that after three years of:- part-time study, supervised teaching, vacation and work experience courses, the students who qualify will receive a Grade 1 Class 1 Trained Teachers Certificate. The students academic background of a minimum of four O-levels, including English Language, is equivalent to that needed for both the College of Education and the In-Service Teacher Training Programme. Since students who successfully follow either of these programmes are awarded the Trained Teachers Certificate, then students with equivalent backgrounds who follow an equivalent course must also receive the same Trained Teachers Certificate. For this to be so, however, the programme must be at least equivalent to that of the In-Service and College of Education Programmes, as can be seen from the aims, (p.4), the content, (p.13), the methods (p.11), and the analysis of work hours below, this programme will be so.

In-Service Teacher Training Programme

Duration of course 2 years part-time/ In-Service
(i.e. six terms of 12 weeks)

Hours of Instruction:

4 hours per day for 4 days per week,
12 hours per term, six terms = 1,152 hours

Classroom Teaching:

5 hours per day for 5 days per week
39 weeks per year, two years = 1,950 Hours

<u>College of Education Programme:</u>

Duration of course 3 years full-time

Hours of Instruction:

27 hours per week
36 weeks per year, 3 years = 2,754 hours

Classroom Teaching:

5 hours per day for 5 days per week
5 weeks per year, three years = 375 hours

<u>Proposed Emergency Programme</u>

Duration of course 3 years Part-time/In-Service

Hours of Instruction:

10 hours per week, 39 weeks per year
three years = 1,170 hours

Tutorial Groups:

3 hours per week, 39 weeks per year
three years = 351 hours

T.V.C.

5 hours per day, 5 days per week
3 weeks, two years = 150 hours

Work Experience Courses:

5 hours per day 5 days per week
2 weeks = 50 hours

Total hours of instruction = 1721

Classroom Teaching:

5 hours per day 4 days per week
39 weeks per year, three years = 2340

Evaluation

It is proposed to assess the programme using both formative and summative evaluation. The programme content will be divided into units and each unit will be evaluated by objective, open-ended and essay-type tests. Included with these will be questions asking the students for self-assessments and for comments on areas of difficulty. Thus it is hoped that feedback from the earlier units will assist in the writing and development of the later work. A summative evaluation of the whole programme, if possible under an independent evaluator, might include a comparison of the teaching technique and science content of a sample of the students in the programme with that of a sample from the College of Education Programme.

Difficulties Still to be Overcome

One of the major difficulties which will have to be faced in the development of this programme arises from the fact that although all the students will have obtained O level standard, they will bring to the course a wide range of science backgrounds. To date 56% of the students have physics, chemistry and biology at O-level, 24% have two science subjects only and 20%, one science subject only.

Thus the material will have to in some areas, start at a level lower than O-level standard. Fortunately the students will all have recourse to the same three basic O-level texts, though the secondary schools and these may be used in the introductory material.

However the variation will not only be in science content but in laboratory skills as well. Thus, many of these with only one O-level, obtained this through private study and may have no experience at all/practical work. Even those taught in some of the junior secondary /of schools will have a limited practical background. Thus there will be a need within the programme to assess and where necessary upgrade basic laboratory skills.

These may be assessed via a questionnaire made up from objective and open-ended items similar to those used by the Associated Examining Board in their assessment of practical abilities for O and A level

G.C.E. subjects, two examples of which are given in Appendix C.

A second major problem arises from the need for supervision of the students in their schools. Even if only 50 of the 80+, O-level acting teachers are accepted for the programme, it will still impose a severe strain on the four science supervisory staff at present serving with the ministry. One partial solution might be to ask the acting teachers own headmaster to submit a report at the end of each term. This could be in the form of a detailed questionnaire which the headmaster would complete and thus could be used as a supplement to the observations of the supervisory staff.

Conclusion:

An outline of a specimen unit of the programme is given in Appendix A. This includes the objectives of the Unit and the list of teaching media and materials to be used for that Unit. Also included in Appendix A is a proposed list of content for Year 1 of the programme.

The need for this programme has been made clear by the report of Dr. Ponnamperuma, the Diamond Workshop reports, the surveys carried out by Dr. Thollairathil in 1974 and the Ministry of Education in 1976, the G.C.E. results and the comments of individuals such as the marketing manager of the Timber Export Board. Unless immediate steps are taken for its implementation we shall continue to try to produce trained scientific personnel using untrained and unskilled science teachers and so simply perpetuate the "dearth" of the scientific and technical personnel so vitally needed for the attainment of our National Science Goals.

A Curriculum Modol for the Programmo Basod on Kerr's Modol for Curriculum Theory is Provided Below.

Objectives

(1) Increase proportion of trained science teachers.

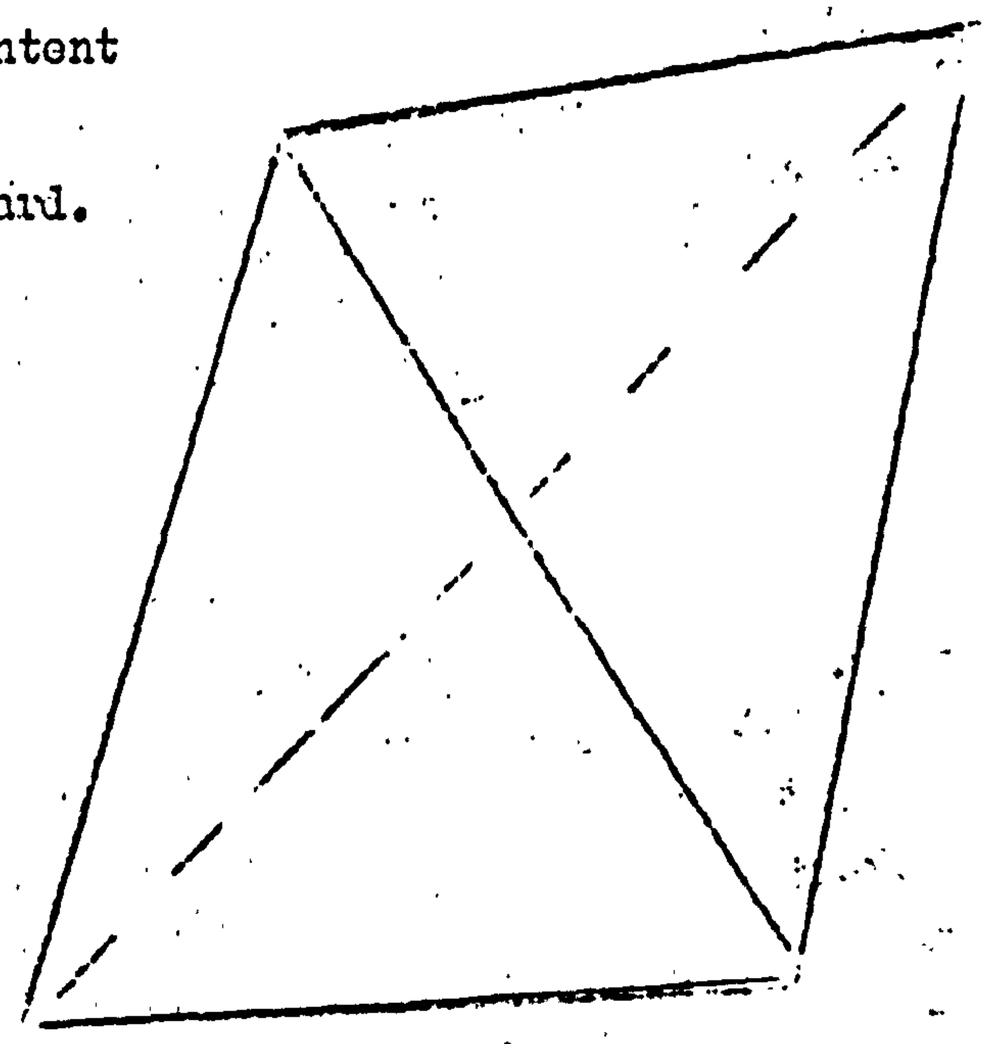
(2) Increase body of teachers with content knowledge relevant to CXC and WISC and Community High School Programme

(3) Provide students with content knowledge of Integrated Science to A level standard.

Evaluation

(1) Formative, using tests interviews, self-assessments

(2) Summative, using an independent evaluator



Knowledge

Content area as for CXC and WISC treated to greater depth with work at higher levels of thinking and with emphasis on applications and relevance.

Learning Experience

Multi-media approach using a guided discovery method based on correspondence texts, practical investigations, tutorials, work experience courses and vacation workshops.

(Ref. 9)

APPENDIX A

[illegible] Unit

OBJECTIVES

When they have finished studying this unit, the students should be able to:

1 (a) Define correctly or recognise the best definitions of the following terms cytoplasm, nucleus, cell wall, plasma, membrane, mitochondria, endo plasmic, reticulum, golgi body, ribosomes, lysosome, chloroplast, nuclear p[illegible]e.

(b) Identify from photographs the major sub-cellular organelles and structures listed above.

2 (a) Identify from photographs or from prepared slides:- epithelium, muscle, nerve, blood and connective tissue and plant epidermal, paracnchyma, phloem and nylon tissue.

(b) Describe how the structure of the above tissues are related to their function.

3 (a) Mount specimens for microscopic examination correctly.

(b) Use the microscope to make observations.

4 Solve simple problems based on experimental data. Relevant to this unit and apply the ideas explained in this unit to new concrete situations.

5 Extract conclusions from data given, propose hypotheses to explain phenomena and suggest experimental tests of hypotheses for information within the general content of this unit.

Teaching media and materials for unit.

For this unit the teaching materials will include:-

1 The list of objectives of the unit, to act as an "advanced organisor" for the students. (Ref. 11)

2. A correspondence text dealing with the content listed in objectives 1 and 2.

3. Photo micrographs and electron micrographs of the various organelles, structures and tissues listed in objectives 1 and 2.

4. A prepared pamphlet on the.:
   (a) care and use of the microscope
   (b) making of a microscope slide
   (c) simple procedure for staining slides

5. A practical exercise to prepare, observe and estimate onion and cheek cells.

6. Self-assessment questions on the unit content to assist the student with his understanding of the content.

7. A tutorial meeting to:-
   (a) discuss with the tutor and follow students any area of difficulty in the unit,
   (b) view prepared slides and electron micrographs of some of thesstructures and tissues dealt with in the unit,
   (c) answer prepared questions dealing with objectives 4 and 5 either in discussion or by written work.

8. A test including objective, open-ended items and structured questions to assess how far the objectives of the unit have been met by; the individual students; the total student population and sub-groups within that population. This will also include items allowing for students comments upon various content areas of the unit.

YEAR I - CONTENT

Science:

What is science? (various definitions)
Process or content.
What is unique about science? (Rf. Jevons)
The social implications of science:
science the liberator, science the enslaver, (simple treatment)
Ref: Marcuse, Hebermas, Feyerabend, Young.
Science and its society. Ref. Rose

Why teach science?
Culture of the society.
Science for technical development
(a) research and development
(b) scientific literacy of population
(c) personal development (efficiency, health)

Cellular Structure:

Scale in science, organisms to atoms.
Cellular structure via the optical microscope, CF plant and animal cells diversity of cells, form and function.
The ultra structure of the cell via the electron microscope
Organelles form and function, the nucleus, mitochondria, endo-plasmic, reticulum, golgi body, lysosmes, chloroplasts
The Plasma membrane.
Tissues from cells: (animal) epithelium muscles, connective, skeletal, blood cell, nerve.
(plant) epidermal, parenchyma, vascular.
Single cell organisms: the paramecium, algea, amoeba.
Movement in and out of cells:
diffusion, osmosis, plasmolysiss
phagocytosis and pinocytosis, active transport.

The Structure of Matter

The elementary structure of the atom.
Size of atoms, atomic number, electron levels, atomic orbitals.

Relative atomic mass, istopes;
The avogadro constant, the mole.
The determination of relative atomic mass, the mass spectrometer, mass defect and binding energy.
Radioactivity, half-life, alpha, beta and gamma radiations and their nature, geiger tube, nuclear equations, spectre, dispersion of light, the visible spectrum, atomic spectra, absorption spectra, emission spectra. The photo electric effect, photons. Plank's constant.
Electron energy shells, ionization energy, energy sub-shells S P D F nomenclamature
Periodic relationships among elements and their electronic structure electron spin - Hund's Rule.
Electrovalent, covalent and metalic bonding.
Effects of type of bond on behaviour and properties.

The elements of Group I - The Alkali metals
" " " " IV
" " " " VII The Halogens

<u>Chemicals of Life</u>

Water as a solvent. Polar molecules.
Thermal properties of water.
Acids and bases. (simple treatment here)
Carbohydrates: mono and disaccharides, the glycoside bond, starch and cellulose
Lipids, proteins, and peptide,bonds, vitamins.
Chemical reactions in the cell:
energy - synthesis and breakdown
activation energy
photosynthesis and the release of energy
aerobic and anaerobic respiration
enzymes, their role in the cell and factors influencing rates of reaction

Wave Motion and the Electro-Magnetic Spectrum:

Photosynthesis and photons.
Light and vision in man and other animals
Optical Instruments - the magnifying glass, the microscope, the projector
Lenses - lens-formula (single)
The nature of light, reflection and refraction at plane surfaces.
Total internal reflection. Critical angle.
The electro-magnetic spectrum, wave-length, frequency and velocity.
The nature of sound, measuring the speed sound.

Approaches to Teaching Science

The teacher centred, the child centred approach.
Active and passive learning.
Discovery and expository teaching.
Trial and error learning.
Conditioning and reinforcement theories.
Programmed learning.

The Curriculum:

What is the curriculum?
aims, objectives, content, methods, evaluation.
The formal and informal curriculum.
Some types of curriculum, elitist, utilitarian, specialist.
Functions of education in society:
political, economic, cultural, social mobility
education as a distribution process
Other people's curricula.
U.K., U.S.A., U.S.S.R., France.

Intelligence:

What do we mean by intelligence?
Intelligence A, B and C.
The nature, nurture controversy.

APPENDIX B

List of schools included in Table 3

1. Alleyne High School
2. Central High School
3. Christ Church Secondary School
4. Covent Garden Secondary School
5. Cummings Lodge Gov't Sec. School
6. East Ruimveldt Gov't Sec. School
7. Guyana Oriental College
8. Indian Educational Trust College
9. North Georgetown Gov't Sec. School
10. Queen's College
11. St. John's College
12. St. Joseph's High School
13. St. Rose's High School
14. St. Stanislaus College

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15. Berbice Educational Institute
16. Berbice High School
17. Central Corentyne Gov't Sec. School
18. Corentyne Comprehensive
19. Corentyne High School
20. Lower Corentyne Gov't Sec. School
21. Manchester Gov't Sec. School
22. New Amsterdam Gov't Sec. School
23. Rosignol Gov't Sec. School
24. Skeldon Line Path Gov't Sec. School
25. Skeldon Lutheran High School
26. Tagore Memorial High School

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27. Annandale Gov't Sec. School
28. Bladen Hall Sec. School
29. Patentia Gov't Sec. School
30. Stewartville Gov't Sec. School
31. Zeeburg Gov't Sec. School

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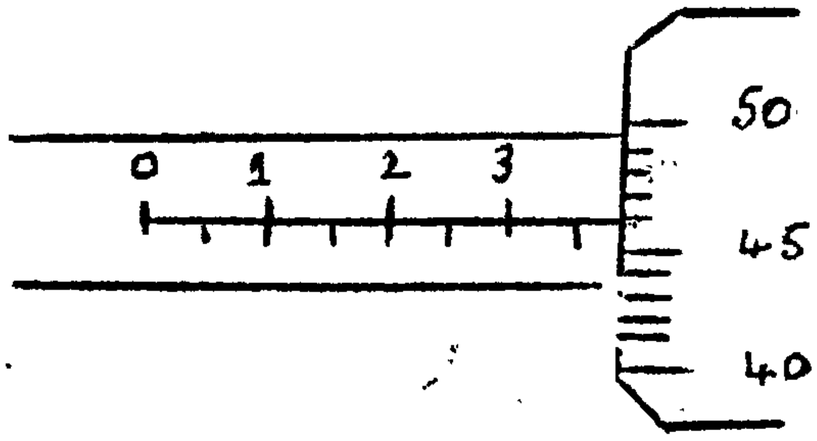
APPENDIX C



What is the reading on the micrometer screw shown in the diagram?

A. 3.46
B. 3.49
C. 3.93
D. 3.96
E. 3.99

(A.E.B. O-Level Physics 1971)

Write down in order a series of instructions for making microscope slides of material such as that used in making the slides which were photographed for question 8. (i.e. mitosis). Include information about fixing, staining and mounting. Begin each instruction on a new line.

(A.E.B. A-Level Biology June 1975)

Ref. 8

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