RHODES UNIVERSITY
DEPARTMENT OF EDUCATION

THE DEVELOPMENT OF AN IN-SERVICE TRAINING PROGRAMME FOR MATHEMATICS TEACHERS ON THE DEVELOPMENT AND USE OF RESOURCE MATERIALS IN BLACK SCHOOLS AT THE STANDARD SIX-SEVEN LEVEL.

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M.A. YALIWE JIYA
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1 THE PROBLEM STATED

1.1 Introduction

Involvement in the teaching of Mathematics in Black South African schools, since 1966, the witnessing of all the changes effected in school Mathematics during this time, and the effects of these changes on the pupils and teachers, have prompted me to get involved with the group of educators who are, the world over, concerned with the Mathematical achievement of their students. There have been changes such as the introduction of the "new" Mathematics and making Mathematics compulsory for all standard six and seven pupils but it must be realised that "... change can produce deterioration as easily as it can produce improvement ..." (Assistant Masters Association, 1973. p1).

The concern is with finding some answer to the question:

"What is the best method for teaching Mathematics successfully, especially to the standard six and seven pupils?"

> "By assumption, the 'best method' is defined as that pedagogy which will increase not only the Mathematical achievement of one's students but also improve their attitude toward Mathematics instruction as well." (Brousseau, A.R., 1973.99).

As this definition implies the inclusion of not only the content of Mathematics but also the teachers who teach it and the pupils who are taught, this calls for some special reference to all these components.

1.2 Teachers of Mathematics

It is true that "The potential of an educational system is directly related to the ability of its teachers." (Griffiths and Howson 1974 p62). This is more true in the case of Black education in this country. The problem of teacher shortage in our education is at its most acute in the area of Mathematics teaching, especially in the standard six and seven classes, and it is not uncommon to find teachers who never had any professional training of any kind teaching these classes. The following advertisement shows this:-

DAILY DISPATCH, THURSDAY, JUNE 9, 1983 — 17

FORBES
GRANT
SECONDARY
SCHOOL
TEACHER
WANTED URGENTLY OR
UNQUALIFIED MALE OR
FEMALE WITH STD 10
MATHEMATICS AND
PHYSICAL SCIENCE
To teach STD 6 and 7
Mathematics and General
Science.
Apply
PRINCIPAL
Box 88, KWT
Phone 0433-21631

The data released by the HSRC bears this out too, even to a greater extent, and on a comparative basis for all races in South Africa. Although the report excludes the national states, conditions are certainly worse in these states.

UNDERQUALIFIED TEACHERS OF MATHEMATICS AND PHYSICAL SCIENCE AND BIOLOGY IN THE DIFFERENT EDUCATION DEPARTMENTS

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AUTHORITY	CRITERION SET	PHYSICAL SCIENCE 8-10			BIOLOGY 8-10			MATHEMATICS 8-10			MATHEMATICS 6-7			GENERAL SCIENCE			REMARKS
		N*	UQ**	%	N	UQ	%	N	UQ	%	N	UQ	%	N	UQ	%	
Transvaal Education Department	B C	441	198	45	480	19'	40	604	244	40	553	283	51	745	474	64	From 1977 HSRC questionnaire to principals
Cape Education Department	A C	417	181	43	425	164	39	739	214*	29	442	236*	53	783	554	71	*1980 data Estimated partitioning of 6-10 Mathematics
Orange Free State Education Department	A C	108	51	47	112	64	57	155	42	27	82	52	63	85	58	68	1980 data
Natal Education Department	B C	170	37	22	167	18**	11	248	42*	17	248	124*	50	266	82	31**	*Estimated partitioning of 6-10 Mathematics ** Criteria
National Education	B C	13	06	46	04	03	75	33	19	64	58	42	72	69	49	71	
Coloured Education***	C	73	51*	70	186	123	66	150	121*	81	302	269*	89	370	263*	71	*Estimates from totals
Indian Education***	F	159	133	84	183	110	60	312	289	93							
Education and Training	D E	670	613*	92	1 239	982*	80	1 373	1 235*	90	1 626	1 138*	70	1 626	1 138*	70	*Rough estimates - not reliable
TOTAL		2 051	1 270	62	2 796	1 661	59	3 614	2 206	61	3 311	2 144	65	3 944	2 618	66	Approximately

*N = Number of teachers engaged in the teaching of the subject

**UQ = Number of these teachers who are underqualified in terms of the criteria applied by their department

*** = Coloured education and Indian education fall under the Department of Internal Affairs

(HSRC. 1981. 63)

To a question on whether he thought that his professional training in the teaching of Mathematics was adequate at the time, one teacher replied thus: "Not applicable to me, as I had no professional preparation of any kind. I do not know what they do in teacher training." Another one said: "I was trained for Primary teaching - P.T.C - so I feel that my primary methods are not quite applicable."

Dr Beeby postulated a model for an educational system to be followed in all developing countries, and he hypothesised that it was impossible to omit any stages in developing any educational system.

His model is the following:-

> "Stage I. <u>The 'Dame school'</u> stage: (italics) at which the teachers are neither educated nor trained.
>
> "Stage II. <u>The stage of formalism:</u> (italics) at which the teachers are trained but poorly educated. This stage is characterised by the highly organized state of the classroom, the rigid syllabus, the fixed textbook and the emphasis on inspection.
>
> "Stage III. <u>The stage of transition:</u> (italics) at which teachers are trained and better educated but still lack full professional competence. The aims are little different from those of stage II but the syllabus and textbooks are less restrictive. Teaching is still 'formal' and 'there is little in the classroom to cater for the emotional creative life of the child'.
>
> "Stage IV. <u>The stage of meaning</u>: (italics) at which teachers are well-trained and well-educated. Meaning and understanding are now stressed, individual difference are catered for and the teacher is involved in the assesment of his pupils. He may now be so confident as to reject any curriculum but his own". (Griffiths and Howson. 1974. 65)"

If Beeby's model is depicting a true situation for what an educational system in a developing country should go through, then Black education might as well start afresh.

We certainly never had a "Dame school", as I believe that even in our informal educational system our 'teachers' have certainly been educated and had received on the job training. As far as formal education is concerned we had the missionaries to teach our first teachers, even though they were not trained.

We are still very much at stage II, especially as far as Mathematics and Science teaching are concerned, yet we have had changes in curricula that have required us to enter stage IV, where the call is for meaningfulness and understanding, but without well-trained and well-educated teachers, sometimes with no trained teachers, let alone 'better educated', as required in stage III. And we are still a long way off having teachers who would go about rejecting curricula other than their own.

Beeby himself says "... an under-educated teaching force cannot be expected to initiate, adapt or even apply new educational ideas without special preparation." (Maynard. 1970. 147). Yet in Black education Mathematics teachers get employed with not even a standard ten pass in Mathematics, as even these passes are very rare to come by from the evidence of examination results.

As a result of being ill-prepared or not prepared at all, these teachers have very little self-esteem, are wary of accepting responsibility, have a fear of teaching Mathematics and are aggressive. Remarks like the following are not uncommon: "I never wanted to teach Mathematics. I was forced into teaching this Mathematics, and I only go through the textbook with the children." These teachers always get blamed - on all sides - for poor achievement, and such criticism is more distressing to these teachers.

> "For the individual teacher a part of his social acceptableness obviously depends to an important extent on the judgement of the school inspector, the school principal and colleagues. Criticism from this side is public criticism and therefore particularly distressing." (Nipkow, K.E. 1981, 100)

The greatest problem of these teachers, however, has to do with the pupils. For them it is a most painful experience when they cannot get through to the pupils. It is a known fact that the kind of 'contact' a teacher experiences with his or her pupils is through a good knowledge of his or her subject. For most standard six and seven Mathematics teachers -

> ".... anxiety is caused not only by the experience of lacking any proper contact with pupils, through which to reveal shortcomings in competence and to be confronted with difficulties in discipline, but also, ... by the fear of being approximately reproved by the relevant professional authorities, of seeing oneself exposed, of not being able to hold one's own, ... and so on". (Ibid p103)

The result? Energy constraint rather than release, insufficient motivation and inadequate learning activity, rote learning instead of meaningful learning.

The problems of these teachers are augmented by the content they have to deal with - content with which many are unfamiliar. This is borne out by one statement made in reply to the adequacy of the teacher training programme: "There was'nt enough time to cover the syllabus extensively especially because some of the aspects in the new syllabus were not in our syllabus when we were at school." This teacher has been teaching for three years. Yet one of the qualities to be possessed by teachers in Mathematics education in the South African context is:

"A wide enough Mathematical background to encompass the range of contents, activities and meanings dealt with in present and possible future school Mathematics curricula." (Nero, R.C. et al 1981. p8)

Mathematics teacher shortage at the standard six and seven level is going to be with us for a very long time still, despite the current move on the side of many Secondary School teachers to enrol at universities to improve their qualifications. For when they do qualify, they very often do not get back to the same schools nor to teach the same classes, if they return to teaching at all. Instead they move up, and the lower standards are again landed with teachers who are underqualified or ill-prepared. Thus starts another cycle. The turn-over is very high, and pastures are greener in the urban areas than in the rural areas.

If anything, these teachers are very much in need of helpful co-operation, which could even result in them realizing their own weaknesses and voluntarily seeking means and ways of overcoming these. For:-

> "The struggle of security can assume yet other forms if teachers do not seek the cause in themselves nor in their colleagues but to put the blame for everything on certain external factors." (Nipkow, K.E. 1981. 102)

"Every effort needs to be made to make their task as straightforward and as interesting as possible." (International Seminar on Mathematics Education. 12-16 March 1979. Swaziland p17). This needs to be done especially that there are always other subjects these teachers have to teach in addition to teaching Mathematics.

1.3 The standard six and seven pupils (13 to 14 year olds)

Black Secondary Schools are bursting at the seams with standard 6s and 7s. This is especially so in the Ciskei. And yet not all children are at school - as would be the case should compulsory education be implemented - greater tensions would arise, because of an increase in lack of motivation, ambition and ability brought about by poor allround conditions.

Pupils coming into standard six, come, in the main, from overcrowded classrooms. "The problem (over-crowdness) probably has a significant influence on pupils' performance in Mathematics in standard five." (Wilkinson 1981. p16)

Not only that, but their teachers are insufficiently equipped to teach Mathematics successfully. "According to statistics of the Department of Education and Training students at teacher's colleges also do poorly in their Mathematics examinations." (Ibid p25)

As a result "... standard five pupils have a poor grounding in Mathematics and they cannot do basic calculations," (Ibid p27) amongst other things. Furthermore "It seems as if most of the pupils are not at all equipped mathematically either to leave school and to enter employment or to receive further secondary Mathematics education." (Ibid p65)

Possible reasons for the poor performance of standard five pupils in Wilkinson's diagnotic tests on common and decimal fractions are cited as a lack of concrete methods and pupil involvement. (p76)

This can be said for the overall poor performance of the pupils in Mathematics. They still need the " ... concrete embodiment of mathematical experiences." (Wain 1978 p169) on entry to secondary school.

Another reason for poor performance stems from the very deprived home environments of the pupils. Marzollo and Lloyd isolate these six very important aspects to the parents' role in their children's learning:

"(i) to understand the skills their child needs to learn;
(ii) to introduce activities and materials that lead to learning;
(iii) to take an interest in learning discoveries;
(iv) to interpret and enlarge experiences;
(v) to relate learning to the child's overall framework of knowledge;
(vi) to have patience with weaknesses and praise for strength." (Marzollo and Lloyd. 1972 p4)

Needless to say the home conditions of the majority of the pupils just do not allow for this role of the parent. Very few homes can provide the child with supportive materials toward meaningful learning - books, toys, let alone parental help, since many parents are illiterate and many are away at work at far away places. Many children are on their own when it comes to their studies. Nobody helps them with homework. Regarding Mathematics homework it is worse. Even outside the home there is, if any, very little the community is able to do by way of supportive projects - setting up of community libraries, recreation centres and so on. For many children, school is the only place where learning can really take place, especially Mathematics learning, and, even there, conditions are far from being conducive to learning.

Parents must, however, make sure that a sense of excitement and love of learning is fostered in their homes - literates and illiterates alike, unfortunately - if future generations are to cope with the future. Teachers need this kind of support from parents. The most effective kind of parent, of course, is the one who accepts his or her child for what the child is, and encourages him or her to develop his or her potential at his or her own rate. Sharing but never forcing the natural development of his or her child this kind of parent seems to sense what all good teachers know or ought to know.

Wilkinson suggests that with Mathematics instruction "... the non-stimulating home environment of the child should continually be kept in mind... Careful consideration should therefore be given to the most efficient methods of instruction, the nature of the curricula and effective instrumental material for standard five education in developing states." (Wilkinson 1981 p107). This applies to other standards as well.

The question of whether Blacks have the necessary mathematical ability has been addressed by van den Berg:

> "The Black people undoubtedly have mathematical ability and intuition, ..., and it seems clear that with the correct approach in the schools, Black pupils can be brought to a competent level of mathematical proficiency as is required in the modern technological society."
> (van den Berg. 1978 p20)

We have to concentrate on how best to develop this potential. Professor Geoffrey Matthews puts it very well when he says: "Finding just what secondary children are capable of learning, and where they are in their development, is indeed harder than at primary level, not only because previous research has been so scanty but also because the number of variables, and indeed the entire complexity of the problem, increase with age." (Hart, K. ed. 1981 Foreword)

In the study carried out by the CSMS (Concepts in Secondary Mathematics and Science) Team, the team came up with findings best summarised in the team's words:

> "In the secondary school we tend to believe that the child has a fund of knowledge on which we can build the abstract structure of Mathematics. The child may have an amount of knowledge but it is seldom as great as we expect ... It is impossible (italics) to present abstract Mathematics to all types of children and expect them to get something out of it." (Ibid pp209-210)

The team's findings hold even more implications for the teaching of Mathematics in our secondary schools on the basis of the background already given. As in the case of the teachers, secondary school pupils especially, need all the sympathy and understanding they can get. Remarks such as: "Sheer laziness and not displaying any or very little keeness in their work", by one of the teachers interviewed are not very sympathetic. Another remark which I keep on hearing is: "Pupils lack foundations in Mathematics. Most of them are not good even in Arithmetic. They fail to correlate mathematical problems with the ones of daily living." Pupils at this level need more sympathy than ever because of the many changes their bodies are undergoing due to adolescence, changes that very often bring about a possible accentuation of strengths and weaknesses, likes and dislikes, abilities and disabilities and so on. This period of puberty brings with it much instability.

1.4 Why teach Mathematics?

> "The primary value of Mathematics is that it is man's chief tool to help him understand his world and to master that world in his belief".
> (Vrana 1973 p11)

Thus this question does not seem to need any answer, as there does not seem to be anybody who can do without Mathematics, be it in a job situation or during a period of leisure or at most the application of the basic rules.

"In Africa, Mathematics has an important place in the school time-table because of its utilitarian significance." (International Seminar on Mathematics Education 12-16 March 1979 p18).

That Mathematics be included in the curricula of Black Education is not at all debatable. Mathematics needs to be made a priority subject if the independent states are to achieve rapid industrialization and the closing of the gap between themselves and Western countries, much the same as was done in the People's Republic of China (Educational Studies in Mathematics 8 461-478).

What is debatable, however, is what content is more suitable to the needs of which individuals, and which methods are more acceptable. Mathematicians in Black education in South Africa - the very few we have - still need to research this area to curb the incidence of frustration of the majority of pupils by making them take content that is most irrelevant to their individual needs and capabilities, resulting in a high failure and drop-out rate. However, as Rose says:

> "The high drop-out level of the system may indicate not so much the low calibre of present pupil intake, as the fundamental inadequacy of the system itself."
> (Rose, B. ed. 1973, 12)

In the past Blacks were not invited to participate in decision making as far as curriculum planning was concerned, only as spectators. "For all purposes, clause 15 of the Bill (1953 Bantu Education Bill) grants the Minister total control of all aspects of Bantu education." (Ibid p70)

Not that things were any different prior to this. Even now Blacks are not able to participate as fully as would be desirable, because of the lack of the necessary expertise to do so. Their education did not allow for that, as their 'guardians' took care of their needs. This is brought out in the article of the Institute for Christian National Education as follows:

> "We believe that the calling and task of White South Africa with respect to the native is to Christianise him and to assist him culturally, and that this calling and task already found its clearly defined expression in the (three) principles of (:) guardianship, no levelling, and segregation.... In accordance with these principles we believe that the education of the native should be based on the life and world view of the European, more particularly, that of the Boer nation as the senior European guardian of the native and the native should be led to a mutatis mutandis but independent acceptance of the Christian and National principles in education, ... Because of the cultural immaturity of the native we believe that it is the right and duty of the state in co-operation with the Christian Protestant .... churches to provide for and control native education." (Ibid p56-57)

With the advent of independent national states - which was envisaged by the ICNE - the Blacks in these states suddenly got thrown into the role of decision makers whereas in the past they were passive recipients. Suddenly they have to draw up curricula and clearly this is an almost futile task. It has been very succinctly put by Wain when he said in the case of Mathematics:

> "Where teachers have freedom to develop their work and contribute generally to aspects of mathematical education including curriculum construction they are able to play a full professional role. Where they have little freedom, are poorly trained and ill-qualified, and are responsible mainly for conducting classes, through well-defined procedures from set textbooks it is difficult to see how they can play the role of the professional." (Wain 1978 p144)

Teachers, in fact all educators, in Black education have to learn to participate in all aspects of mathematical education. Mistakes, there will be, by the score, but it is the only way in which learning will take place. The exercise is needed.

It is against the background of ill-prepared, over-loaded Mathematics teachers, in over-crowded classes, with pupils whose basics in Mathematics are generally poor, and whose textbooks give very little guidance on how to teach their subject, that I undertook this study.

2 THE AIM OF THE STUDY

The aim of this study is to identify materials available to, and capable of being successfully used by, the standard six and seven Mathematics teachers in Black schools.

> "Fundamental research regarding Blacks which was consulted showed that they live closer to nature and are more part of their environment than the European. For this reason Black people have difficulty in "removing" themselves from their surroundings in order to view a situation abstractly. Yet, there is strong evidence that they are able to mathematize real situations without any difficulty..." (v.d. Berg. 1978 p72)

It is precisely this statement that has directed my efforts to the use of materials in the teaching of Mathematics. Let alone the fact that "Most people tend to be visual-minded." (Butler et al. 1970 p149), and that "The best way to learn Mathematics is to do Mathematics..." (Watson 1976 p13). Why not exploit that which comes naturally to the Black child according to van den Berg? Why not change the 'problem' into an 'opportunity'?

Being closer to nature need not be derogatory but an advantage. If there is a natural tendency for Blacks to structure their world from concrete evidence, one may wonder why it is that some of the abstract concepts one was taught at school were so difficult to understand. This may have happened because some of the concepts taught were rote learned and not derived from concrete situations.

Using the concrete approach would be more rewarding than the present completely abstract approach which is mostly out of the reach of the children. A door opens only when it is pushed in the direction allowed by the hinge: While better qualified teachers are still in the making, and those who are in position are trying at a great sacrifice to keep the teaching of Mathematics at a relative high, we have to try and make their task easier, enjoyable both to them and their pupils, and more rewarding. Polya, in any event, says:

> "If the teacher has had no experience of creative work of some sort, how will he be able to inspire, to lead, to help, or even to recognise the creative ability of his students? A teacher who acquired whatever he knows in Mathematics purely receptively can hardly promote the active learning of his students. A teacher who never had a bright idea in his life will probably reprimand a student who has one, instead of encouraging him." (Watson 1976 p13)

Many Mathematicians believe that Mathematics necessarily involves active participation. I cannot hope to give these teachers all the awareness, skills, methods and attitudes they need, in order to become successful and proficient Mathematics teachers, nor do I hope to take from them whatever creativity and initiative they might possess. This should be seen as only one aspect in the programme of improving Mathematics teaching at standard six and seven level, for:

> "In the final reckoning, better teachers are more important than better diagnosis, better methods, better content, better working conditions, better materials, visual aids, equipment, name what you will. For the teacher is a creative force in the educational process from whom all these other things ultimately spring." (Cundy 1976 pp88-89)

3 THE SAMPLE

Although this study is aimed at all Black schools in South Africa - aimed at the use of materials in the teaching of standard six and seven Mathematics to help improve Mathematics instruction - it will be limited to the standard six and seven teachers in the sixteen schools that fall in the Alice Circuit which is in the Ciskei.

All schools in the Ciskei are under the control of the Ciskei Department of Education, based in Zwelitsha, and are grouped into circuits each with about sixty Primary schools and up to seventeen Secondary schools. The Alice Circuit has fifty-four Primary schools and seventeen Secondary schools one of which has no standard sixes and sevens.

The majority of Secondary schools in the Ciskei are rural and so are the majority of schools in all the independent states and most face the same problems outlined before. So findings, regarding the use of materials in schools in this area, will possibly hold reasonably well for the majority of Black Secondary schools even though randomization in sampling has not been possible.

Regarding the population in the Alice Circuit we have the following statistics for the year 1983 as per quarterly returns June 30.

Teacher population:

Primary	:	384
Post-Primary	:	203

Pupil population:

Primary	:	15 670
Post-Primary	:	5 574

The ratio of teachers to pupils in the Post-Primary schools of 1:28 is misleading as far as the standard six and seven classes are concerned, as the percentage population of the standard sixes and sevens per school is well over fifty except in the case of three schools. The following table will bear this out. This means that the majority of the school's population is doing Mathematics with few of them taught by teachers with Mathematics qualifications beyond matriculation Mathematics - few are taught by graduates. The prevalent professional Mathematics qualification is the Junior Secondary Teacher's Certificate (J.S.T.C): followed in the majority by people with School Leaving certificate in matriculation but not necessarily with a pass in Mathematics), and the other qualification is the Higher Primary Teacher's Certificate (H.P.T.C.: done by people with a standard eight certificate).

POST-PRIMARY SCHOOL	TEACHER POPULATION	PUPIL POPULATION	STD 6 & 7 POPULATION	PERCENTAGE STD 6s & 7s
A	20	373	217	58,3
B	13	466	286	61,4
C	14	551	263	42,8 +
D	15	424	248	58,5
E	5	210	210	100,0
F	4	127	127	100,0
G	23	725	287	39,6 +
H	15	414	267	64,5
I	8	308	233	75,6
J	19	823	371	45,1 +
K	7	154	107	69,5
L	9	238	163	68,5
M	33	304	187	61,5 ++
N	3	50	50	100,0
O	2	69	69	100,0
P	6	238	199	83,6

(++ - The only boarding school and as would be expected with the least pupil-teacher ratio - 1:9, but even here standard 6s and 7s are taught by JSTCs)

(+ - The only schools with a standard 6 and 7 population of less than 50%).

This majority needs to be taught well, for "There is no chance of any country becoming scientifically self-sufficient if its schools cannot teach Maths-and teach it well." (International Seminar. p24)

4 METHODOLOGY

This study was undertaken with the assumption that optimum results can be obtained from a Mathematics programme that encourages pupils to manipulate devices, to solve puzzles, to play games, to gather data, to form conclusions, in fact, to become actively involved in Mathematics learning. This assumption parallels Mathematics teaching with Science teaching. In Science teaching there has always been a concern for providing special physical facilities and special instrumental devices to give meaning to various concepts and relations, and it has, thus always been much easier to motivate the pupils, and to increase the effectiveness of Science instruction. There has even been a project started for the improvement of Science teaching in Ciskei - The Science Education Project (SEP) - 1976. The same could not be said for Mathematics teaching. Even now, with the advent of Mathematics laboratories, we still cannot say the same for the teaching of Mathematics in Black schools. Yet:

> "The use of multisensory aids when well co-ordinated with the other classroom learning activities, can serve a double purpose, namely, to stimulate interest and provide a most effective means of clarifying many Mathematical concepts and relations through the experience of associating them directly with physical things." (Butler et al. pp149-150)

An added incentive to this study is that pupils coming into standard six have had very little, if any at all, concrete experience. So, when they should be at the Formal Operational Stage, according to Piaget's theory, they are still basically at the concrete operational stage, and Post-Primary teachers very often overlook this discrepancy. We have to remember that the standard fives and sixes and sevens - "The top of the junior school and the bottom of the secondary school - ... - once referred to as 'the golden age of teamwork', is also the golden age for pursuing hunches and satisfying curiosity. It is the period during which attitudes to life and objectivity are critically determined." (Marjoram. 1974 p137)

We have to try, therefore, in Mathematics, to relate our Mathematics and language to real problems of life (Ibid p138).

The following method of research was decided upon:

4.1 A review of relevant literature on mathematical teaching using resource materials.

4.2 Attending workshops and conferences, as well as continuing to run my workshops and seminars, to collect information from standard six and seven Mathematics teachers on resources they might have used or could use in conjunction with the Mathematics topics they teach.

4.3 Gathering information on the audio-visual aids that can be applied to the various topics in the standard six and seven Mathematics syllabi.

> "It is likely that much could be achieved by working with local materials, as has been amply demonstrated by those people concerned with innovating in the field of Science Education in developing countries".
> (Maynard 1970 p132)

4.4 Preparing a general guide for the teaching of Mathematics in the standard six and seven classes.

CHAPTER 2

HOW HUMANS LEARN VARIOUS CATEGORIES OF CONTENT

CONTENTS

1 PREAMBLE

Although it is impossible to understand human nature to its fullest extent, it is imperative, however, for all teachers of all subjects to try and know something of human nature, if they are to make a worthwhile contribution towards the education of humans. This thought is very well expressed by Arasteh.

> "... one cannot discuss how much of the endless story of man is truly told and how much of it must be included in unkown facts, but it should be noted that essential to educational practices is an understanding of human nature.
> ... An awareness of man's potentialities can stimulate educators to give their students more initiative learning."
> (Arasteh. 1966 146-147)

It has been found that there basically is no difference in the way humans from different cultural backgrounds learn. This means that the learning processes of all humans are subject to the same general principles of learning, but with a difference. For the culturally disadvantaged, for instance, "... all need to proceed from the concrete to the abstract, .." like all others, "... but there is a difference in what is abstract and what is concrete to students who have gaps in their cognitive and verbal development and whose life experience may be limited in certain areas." (Taba. Elkins. 1966 65-66)

For our efforts to be successful there should be a close link between teaching and learning. Learning, in Gagne's words, is "... a change in human disposition or capability which persists over a period of time, and which is not simply ascribable to processes of growth." (Siann & Ugwuegbu. 1980 p88) Many of us think that it is not our business if pupils do not learn, as long as we have performed our task of teaching. When nothing is learnt, we are quick to blame the pupils - who are victims of our methods of teaching. Of course, most of us are victims of methods that were used on us - we teach as we were taught. But we need to be broadminded enough to want to break a vicious circle.

(Travers et al. 1977 p90)

Matters are worsened by this pre-occupation with "finishing the syllabus" - a syllabus that gives very little guidance to teachers, anyway, making it even worse for those who have inadequate skills, all the same.

2 HOW HUMANS LEARN CERTAIN CATEGORIES OF CONTENT

2.1 General

> "Teaching methods, including ultimately the fine detail of lesson planning, are intimately bound up with our knowledge of human learning as well as with the aims of teaching - .." (Wain & Woodrow. 1980 p30)

Knowing what learning is, is insufficient, as we have then to know when pupils are "ready" to learn whatever concepts we want to teach them. As children bring with them their strengths and weaknesses, likes and dislikes, abilities and disabilities, all of which affect their general performance in the teaching - learning situation, there is a great need for teachers to know something of pupil development. Knowledge on how they develop will help us know when they are "ready", for what. And since development is a never ending process, even teachers need to recognise the need for growth within themselves, and strive towards development. The very recognition of this means growth, and this means more hope for an understanding of pupil development.

2.2 Directions of pupil development and the implications for a mathematical structure.

2.2.1 Physical development

Although not all facts regarding physical development are relevant to formal education, some strongly influence educational practice and planning, and, therefore, knowledge of physical development is a must for all teachers.

The primary school teacher needs to work out tasks that will involve motor skills, to help the child to develop more graceful and controlled actions. Projects involving the telling of time, money counting, measurement of length, volume, mass, and so on, should help if carried out by the pupils themselves. The essentials of primary school work "... are the provision of an adequate environment as a basis for a practical approach,... (Assistant Masters Association 1973. p52)

Secondary school pupils should be allowed to work very much like the primary school children, doing projects that they will be able to succeed in, giving them a sense of confidence, to help them find themselves during a period that brings a lot of problems for many of them - the period of the onset of adolescence. This is also the time to introduce as much argumentative work in Mathematics as possible -proofs of theorems, giving reasons, making statements to develop logical thought - so necessary for maturation.

2.2.2 Language development

Although it is not yet known what goes on in the human mind for language to develop, never-the-less language plays a key role in the process of education.

How much development the speech of a child undergoes, greatly depends on the opportunities the child gets for conversation. An indifferent atmosphere or even an atmosphere charged with fear is most likely to produce a timid child-one who may even be afraid to ask questions, this resulting in suppressed curiosity, a necessary ingredient for the development of an intelligent interest. However it is believed that in spite of a poor start, children from deprived environments often 'catch up' in the later life, provided a radical improvement in the environment occurs.

If a child is taught Mathematics through the language the child hears, speaks and thinks in, then the problems the child would have to face when acquiring concepts are not as many. In the main, the child would be struggling with "... concepts ... as opposed to struggling with concepts as well as the language in which concepts are conveyed." (Swaziland. 1979 p43)

The adoption of English as medium of instruction in our post-primary schools should not be seen against a background of Xhosa being considered inadequate as a scientific language, but rather against the background that English is an internationally recognised and viable language. We, too, have to survive in the dynamic international community, but must stick to simple English. "Let us leave eloquence in the mastery of English as a language to the English people. We have our own problems to master." (Swaziland. 1979 p46)

Even when Xhosa is used as medium of instruction let us use English words and adapt them to Xhosa rather than coin our own, where ever possible. The use of words like "isile" for "carbon-IV-oxide" and "umongomoya" for "oxygen" have proved to be no more successful than the use of "ikhabon-IV-oksayidi" and "ioksijen". Instead, it has been more traumatic for children to change over from 'isile' at primary school level to 'carbon--IV-oxide' at secondary school level.

2.2.3 Social development

"... without interchange of thought and co-operation with others the individual would never come to group his operations into a coherent whole ..." (Copeland. 1974 p360)

Research such as that of Murray (1974), Zimmerman and Lanaro (1974) and Mugny and Doise (1978) has shown there to be "... an improvement in children's ability to solve cognitive problems after experiencing some social interaction." (Mackie. 1983 p131)

When planning Mathematics lessons, therefore, provision should be made for group activities, to accomplish the wider aim of education, namely the socialisation of pupils. Activities which encourage questions, and interchange of ideas could ultimately lead to co-operation.

We should not lose sight of Mugny and Doise's (1978) findings concerning behavioral differences in interactions between children at differing ability levels, findings that are consistent with those of Miller and Brownell (1975).

> "... children who have the correct answer to a problem differ on several behavioral dimensions from those who do not. Typically they are more confident in presenting their own solutions and less hesitant in discounting others." (Mackie 1983 p133)

2.2.4 Moral development

> "... the teacher is a moral and political agent of society; this task is of course, the subject of ideological battles from which Mathematics teachers cannot stand aloof." (Shuard & Quadling. 1980 p129)

All cultures survive through their moral values and attitudes, and school, consciously or unconsciously, as an institution playing an important part in maintaining the culture of a society, also plays an important role in fostering values and attitudes.

Cheating, lying, are the most common moral issues encountered in school. It is thus important that children be encouraged to pursue their work at their own rate and level, with purposes they have come to adopt as their own, so as to try to rule out cheating and lying. Rath and others suggest the following ways in which teachers can help value and attitude formation:

> "1 Encourage children to make choices and make them freely.
>
> 2 Helping them to discover and to examine available alternatives.
>
> 3 Helping them to weigh the consequences of each alternative.
>
> 4 Encouraging children to consider what it is they prize and cherish.
>
> 5 Giving them opportunities to demonstrate their choices.
>
> 6 Encouraging them to act, behave, live in accordance with their choices".
> (Yelon & Weinstein 1977 p279)

Children need to be guided in making responsible choices in preparation for when they would have or approach complete freedom of choice, in later life, when they would then find it easy to take responsibility for the consequences of choices they have made.

2.2.5 Cognitive development

2.2.5.1 Piaget's Theory

"... development in the child's thought process through his adaptation to the environment and assimilation of information ..." (Dictionary of Education. 1973. p176) is what constitutes cognitive development, according to Piaget.

The research he carried out made him to conclude that the mental growth of children goes through specific stages, where later stages are dependent on those going before them.

Irrespective of the ages at which this happens, his theory describes two major levels of logical reasoning in human intellectual development:- the level of concrete thought, and the level of formal or abstract thought, each level with its own reasoning patterns concerning the classification of observations, interpretations of data, drawing of conclusions, and the making of predictions.

2.2.5.2 Implications

2.2.5.2.1 General

"... Educators and Psychologists have pointed out that the logical reasoning abilities identified by Piaget, such as conservation, may be essential for solving a variety of mathematical problems......" (Hiebert. 1981. p43) and up to now nobody has been able to offer a more comprehensive account of the development of logical thinking than that of Piaget.

2.2.5.2.2 The advantages of Piaget's theory

Piaget's theory has been most advantageous in two major areas - that of research and that of educational practices. "... it has been a major source of ideas for research, and ... has also become a focal point for rethinking educational practices." (Travers. 1982. p214)

2.2.5.2.3 Shortcomings of Piaget's theory

Brown and Desforges (1979) have come up with some criticisms of how Piaget interpreted his data - they do not question his data, however, as this can easily be reproduced. A summary of these criticisms follows:

> "1 Certainly, infants are cognitively much more sophisticated than Piaget assumed them to be.
>
> 2 The relationship of thought and language is not clear in Piaget's theory, and when there is believed to be thought without language, one cannot identify in the theory what takes the place of language.
>
> 3 Stage theory has come under fire for a number of reasons. A person who has achieved the level of formal operations is expected to use formal thought in handling the problems encountered in daily life .... Most individuals operate at all intellectual levels, and may operate only at the highest level on certain occassions.
>
> 4 Piaget failed to give proper recognition to the fact that the capacity to perform logical operations is highly tied to situations that are very familiar.
>
> 5 Piaget's theory ... does not allow for individual differences .... Piaget expected that, with a good educational environment, nearly all individuals should achieve the level of formal operations.
>
> 6 Critics have also questioned whether the stages of Piaget's theory show sharp transitions and clear differentiations of the kind that Piaget describes. Ennis (1975), for example doubts that concrete operations can be clearly differentiated from formal operations in terms of the rather vague criteria provided.

> 7 ... the theory is over elaborate. It involves a complicated superstructure of ideas that goes far beyond anything that can be verified at the present time." (Ibid)

All said and done, the basic facts discovered by Piaget in fifty years of research remain undisputed and bear great implications for a mathematical structure.

Piaget supplied us with data on the ways in which intellectual structures develop. "... But we must look elsewhere for data on learning that results from international attempts to change behaviour." (Farrell & Farmer. 1980. p125)

2.3 Rote learning versus meaningful learning

(Often equated to reception learning versus discovery learning)

2.3.1 General

> "What kinds of principles are retained best? What circumstances, such as review and usage, tend to maintain retention of what has been learned? It is of course, true that retention studies are not easy to do, and that they inevitably take a certain amount of time. Yet, it is remarkable how little is known of the facts affecting retention beyond strictly anecdotal evidence." (Gagne. 1972. p172)

Some research studies have shown, however, that the meaning of the material to be learnt is a prime factor associated with its retention. (Farrell & Farmer 1980). "Even the most cursory reflection on the nature and extent of the subject matter you are preparing to teach underscores the need to give careful attention to the central task of ensuring meaningful learning." (Ibid)

Shulman illustrates this sentiment with the following example:-

> "The student who, when confronted with a problem of dividing one fraction by another, knows that he must 'invert and multiply', but has not the faintest idea why, has mastered a process rotely. The student who has mastered his multiplication tables and understands the conceptual relationships among the various orders of multiplication has mastered a product of sets of products meaningfully. Finally, the student who has learned to apply a heuristic or set of heuristics when confronted with the problem of estimating a particular solution in an arithmetic problem and who understands why the heuristic works has come to master a process meaningfully." (Shulman. 1970. p38-39)

Most teachers do not give much importance to understanding, and are, to a large extent, to blame for their pupils not bothering about understanding, before commiting to memory. There is nothing wrong with rote-learning if what is being learnt is understood and can be used. There are materials whose learning requires some rote learning. "But such rote learning need not be dull and monotonous." (Siann. & Ugweugbu. 1980. p114)

> "Understanding and meaningfulness are rarely if ever 'all or none' insights in either the sense of being achieved instantaneously or in the sense of embracing the whole of a concept and its implications at any one time." (Weaver. 1970 p338)

And this is why we need to plan our work in such a way that our pupils have recurring but varied contacts with the basic ideas and processes of Mathematics, so that their understandings of Mathematics grow within them throughout their school life. A tall order for people who have had no such experiences!

What are the conditions for meaningful learning?

2.3.2 Conditions for meaningful learning

Siann and Ugweugbu isolate three conditions that might be useful in bringing about meaningful learning:

> "(a) The materials to be learned must be capable of being organized in some 'non-arbitrary' way. That is, there must be some structure or organization underlying the material.
>
> (b) The learner must possess ideas to which he can relate the material.
>
> (c) The learner must want to relate his previous ideas to the new material in an organized manner." (p114)

These conditions, rightfully, place the pupil at the centre of the teaching-learning situation, but there is still a tremendous backlog on the kinds of experiences needed by teachers of Mathematics on material organization and the pooling of ideas. The teachers are themselves at a loss. The way they were taught and what they were taught made sense only to a few if any. Mathematics teaching possibly needs more confidence than any other subject at school, because of its abstract nature. One needs to build up quite a bank of resources, to illustrate these abstractions. Most teachers carry out their task of teaching as if to say that the learning process comprises reception learning - where the teacher talks about content as if he knows everything about it and the pupils meekly listen and are expected to adapt to the content.

For the reason that pupils "receive" all the time, reception learning has come to be equated with rote learning as opposed to meaningful learning. Yet:

> "If the new content becomes substantially related to ideas already present in the individual's cognitive structure, then meaningful reception learning has occurred. If this condition is not met, then rote reception learning would be the appropriate descriptor." (Farrel & Farmer. 1980. p129)

On the other extreme end there are some teachers - very few and far between - in Black education - who categorise the learning process as discovery learning - discovery learning meaning different things to different people. Some think of it as a process where pupils arrive at an important truth after answering "yes" or "no" to a certain number of questions. "This system is exemplified in some of Socrates' teachings as reported by Plato." (Willoughby. 1970. p269)

Another group think of discovery learning as a process where pupils are presented with a particular situation by their teacher, and are encouraged to think about the situation and to draw specific kinds of conclusions from the situation. "Presumably, the kinds of situations differ depending on the maturity of the children, the subject matter being taught, and the other conditions existing at the time." (Ibid)

> "A far more radical notion of the discovery approach has the teacher asking the children what they want to learn as of the moment and then proceeding from there." (Ibid)

Any of these notions can be made to work depending on the conditions prevailing, and just as in the case of reception learning, discovery learning too, may be either meaningful or rote. (Farrell & Farmer . 1980) Shulman's table shows how reception and discovery learning can be equated with rote and with meaningfulness,

	ROTE	MEANINGFUL
RECEPTION	Memorize multiplication tables	Learn to solve problems of adding number series
DISCOVERY	Use trial-and-error procedures to calculate square roots	Work from a set of specific examples to induce a mathematical rule.

(Shulman. 1970. 38)

"Hence, all that is discovered is not meaningful; all that is received is not rote." (Ibid)

2.4 Categories of human learning

2.4.1 General

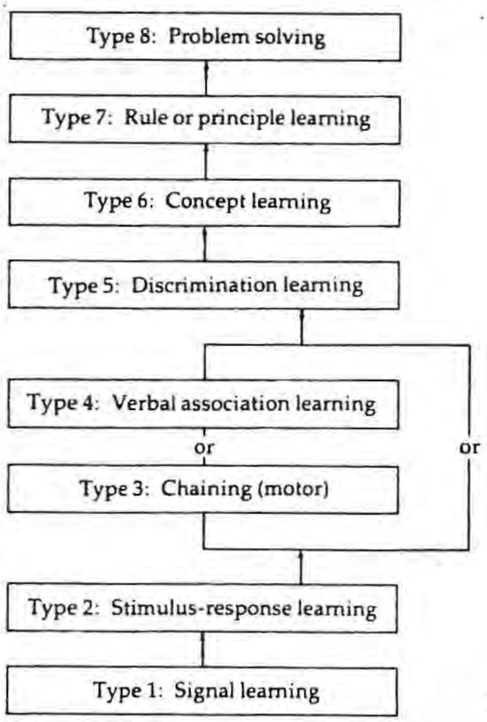
> "In spite of protests that learning theory is in a very immature state and so is not ready to provide a basis for teaching theory, there is a considerably body of common psychological knowledge that we can trust well enough to use for a basis for teaching strategies and tactics".
> (Clark. 1968. p100)

One of the learning theorists who came up with a theory on learning that holds suggestions more specific for instruction than any other theory, is Gagne. He has not only conducted continuous experiments using human subjects, "... but much of his data have been collected in existing classrooms as opposed to the carefully controlled and contrived environment of a pseudo-class in a college laboratory." (Farrell & Farmer. 1980. p130)

Through Gagne's research two principles of importance for instruction have emanated: that is the principle of distinctive conditions for different kinds of learning and the principle of cumulative learning.

2.4.2 Kinds of learning

Gagne isolates eight major kinds of mental processing that could be called learning. Each kind has its different set of conditions required for its optimal occurrence. These conditions embrace Gagne's principle of distinctive conditions. He considers that the typical learning of all students partake of any or all of these types of learning, but that, in the school environment, some types are much more frequent than others. His principle of cumulative learning is illustrated in his arrangement of the learning types in an hierarchical fashion.



(Farrell & Farmer. 1980. 131)

This arrangement of learning types takes care of the problems of making learning meaningful - whether it be reception learning or discovery learning.

These learning types may be equated to instructional objectives - which are better put in terms of pupil behaviour, "what is it we want the pupil to be able to do?" And although in Mathematics we are more concerned with teaching the pupils the ability to discriminate, followed by concept formation, followed by rule learning and finally problem solving, "... the hierarchical nature of learning makes it imperative to have at least an acquaintance with all eight types of learning." (Farrell & Farmer. 1980. p132)

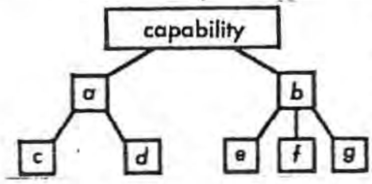
Shulman discusses Gagne's model thus:

> "If the final capability desired is a problem-solving capability, the learner first must know certain principles. But to understand those principles, he must know specific concepts. But prerequisite to these are particular simple associations or facts discriminated from each other in a distinctive manner. He continues the analysis until he ends up with the fundamental building blocks of learning-classically or operantly conditioned responses." (Shulman. 1970. p31)

Gagne, of course, envisages a number of prerequisites between capabilities. In other words, depending on what the desired ultimate capability is, there would be a number of tasks a pupil would have to be able to perform before being able to attain this ultimate capability. For example, for a pupil to be able to add fractions, the pupil must know how to find the lowest common denominator of the fractions, and finding this needs the pupil to be able to factorise, divide and multiply. This is the origin of cumulative learning which has broad applicability to the learning of all principles. Needless to say that "Gagne's analysis of learning types led to the development of techniques called task analysis." (Farrell & Farmer. 1980. p137)

2.4.3 Task analysis

Gagne has given a number of cues (to teachers) on how to extract (from their pupils) prerequisites to their being able to perform certain tasks. He analyses each task and then asks the pupil "what would you need to know in order to do that?" This question might be repeated if there are other prerequisites, until a complex pyramid of prerequisites emerges. Such a build-up of prerequisites may be illustrated as follows:-



(Shulman. 1970. 31)

"Capability" refers to the ability to perform certain specific functions e.g. "to solve a number series."

The model shows that to complete the ultimate task - capability - the pupil has to perform tasks a and b first. But to be able to perform task a, on the one hand, the pupil has to be able to perform tasks c and d first, and to be able to perform task b, on the other hand, the pupil must be able to perform tasks e, f and g.

After the completion of a whole map of prerequisites for the performance of the ultimate task, Gagne " ... administers pretests to determine which (prerequisites) have already been mastered." (Shulman. 1970. p31) The establishment of requisites leads to the development of a very tight teaching program or package.

A teacher-training programme that seeks to help student-teachers establish all prerequisites going with the various mathematical tasks pupils are expected to perform, could be very helpful in solving the problems of Mathematics education.

Robert Gagne provides us with a very good example below:

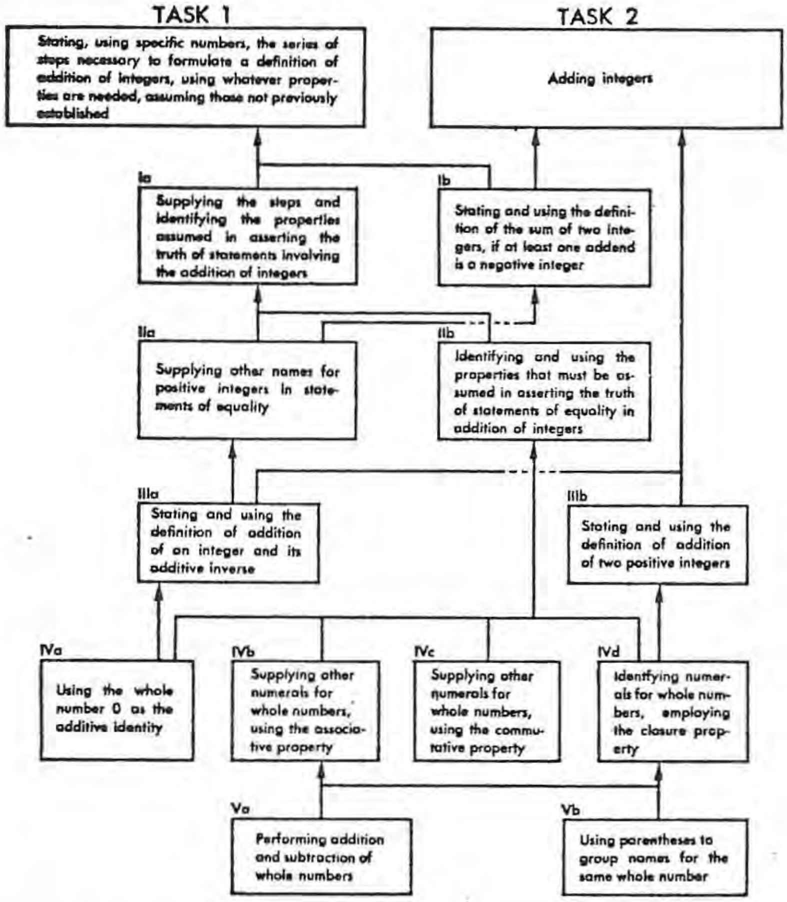


FIG. 1.—A task hierarchy for objectives of assigned tasks. (From Robert M. Gagné, "Learning Hierarchies," *Educational Psychologist*, VI [November, 1968], 1.)

(Shulman. 1970. 32)

In the workshops that I have been running for the local teachers, I have been requested by the teachers, again and again, to supply them with prerequisites to the performance of many mathematical tasks.

One teacher had this to write on the question "What suggestion do you have for the improvement of the teaching of this section?" (The first question in this questionnaire was "what problems do you have with the teaching of ...?" - the teachers had to fill in the particular section/s that were most bothersome to each individual):

> "Give the teacher a good approach to that subject and then have a follow up to make sure she or he does do that. And again, in the workshop have the teachers construct these things so that they may not feel unsure to do them in class. And too, emphasize on the important parts that are a step to the other parts." (Underlining mine - to illustrate the need for "prerequisites.")

Another teacher, whose problem seemed to echo the problem of most participants - "Decimal fractions" - had this suggestion to make:-

> "(a) More time be given on decimals.
>
> (b) Be certain that they (pupils) really know or they have grasped each part before passing to the other."

Yet another comment was "More workshops should be held in order to foster more skills into the teachers so that they, in turn, may use them in teaching."

These are the heart breaking comments from one other teacher which are echoed by many. To "what problems do you have ...?"
The reply is as follows:-

> "(a) The pressure by officials for time limit.
>
> (b) Little knowledge of the subject.
>
> (c) Lack of interest in the subject.
>
> (d) To teach it just because I'm compelled to.
>
> (e) Most problem area is decimals."

To "What are the difficulties of the children ...?
The reply is as follows:-

> "(a) It seems as if the failure is on my side.
>
> (b) They just don't get the whole meaning."
>
> "If may be they (children) can be driven to the correct direction they may follow."

To "What suggestions do you have ...?" The reply is: "I must first be put on the right direction. Children too to be encouraged."

All these comments reflect the sentiments expressed by Lovell when he said: "The two most important factors, external to the child, likely to affect the development of mathematical concepts are:

> "(a) the mathematical understanding of the teacher, and
>
> (b) the climate of opinion in which the child is reared." (Lovell. 1966. p150-151)

Explaining (b) further, especially for teachers in Black education, this is a plea that we develop ways of convincing our young that education is worthwhile, that it is important and that it can make a difference in their lives within their lifetime.

> "We must increase the success experience of young people in schools so that failure does not become a self-fulfilling prophecy. It is imperative that we uncover new and valid ways to improve and strenghten the self-concept of our young people so that they feel worth-while, so that they love and respect themselves, so that they are self-accepting ... psychological research tells us that success in school and the commitment to stay in school are highly correlated with good feelings about oneself, with the ability to set realistic expectations, and with a history of success experiences."
> (Harleston. 1983. p96)

3 CONCLUSION

In spite of the many differences occuring in learning theories, all theories seem to accept the list of learning principles - considered to be basic to the educational process - developed by a committee of Wisconsin educators in 1961.

"Principle No. 1: Learning is governed by the readiness of the learner.

Principle No. 2: Intent to learn (motivation) is necessary for purposeful learning.

Principle No. 3: A person tends to believe according to how he perceives a situation (perception).

Principle No. 4: Goals must be clearly in mind and accepted by the learner if adequate learning is to take place.

Principle No.5: Learning varies with the individual. (individual differences)

Principle No. 6: Learning is useful when a person can retain and apply it to new situations. (Transfer and retention).

Principle No. 7: Cognitive learning involves recognition and/or discovery.

Principle No. 8: An individual's affective learning determines how he relates himself to new experiences.

Principle No. 9: An individual's psychomotor learning determines how he is able to control his muscular activity.

Principle No.10: The kind, the extent, and the validity of evaluation affect present and subsequent learnings." (Clark. 1968 chapter 5)

Teachers need to be made aware of these principles, during pre-service and in-service.

CHAPTER 3

A CRITICAL ANALYSIS OF THE DIFFERENT MODES OF TEACHING

CONTENTS

1 INTRODUCTION

The effectiveness of any instructional strategy is closely linked with where one is leading those being instructed to. In the study of the pedagogy of Mathematics we need to make a distinction between what we call 'method' and what we call 'mode', although this distinction is not always easy to make, resulting in 'method' being used synonymously with 'mode'. 'Method' should be considered as the " ... manner in which the subject matter is arranged and developed", and 'mode' " ... as the manner in which it is presented to the pupils". (Young. 1968. 287) Yet " ... not all processes of instruction can be readily classified as relating exclusively either to the sequence and interrelation of the subject matter or the devices by which it is made clear to the pupil". (Ibid)

> "Without good diagnosis one does not have an adequate basis on which to make a selection of strategy or tactics. Obviously, good diagnosis depends upon an analysis of as many of the variables in the particular teaching-learning situation as possible under the circumstances". (Clark. 1968. 3)

Some of the most important variables affecting instruction are: (1) objectives, (2) pupils - each pupil being unique, with his or her own interests, abilities, attitudes, potentials, background, goals and learning styles, (3) the nature of the subject matter, (4) available technology-techniques and tools of teaching. "The teacher who has a large repertory of teaching techniques, backed up with a good store of materials and equipment, has potentially a great advantage over the teacher who does not have these assets". (Clark. 1968. 4); (5) the environment surrounding the school - including both the community in which one lives and society at large.

"A physically dingy school, housing a social milieu hostile or indifferent to learning, usually requires somewhat different techniques from those suitable for schools containing more favourable environments". (Ibid); (6) teachers, too, bring with them individual differences, which, in turn, bring about individual differences in teaching styles.

If one wants to cater for all the members within one's class, one would have to know something about the variety of instructional modes that are available in teaching. This is especially true for Mathematics teachers, the majority of whom are ill-qualified, and thus feel more comfortable teaching in the traditional way.

Different topics in Mathematics will have different objectives as seen by each teacher. These objectives may be classified as falling under the affective domain, the psychomotor domain or the cognitive domain, whatever the case may be. For different objectives to be successfully attained, one would have to use different modes of instruction. One could use the same mode but stress different aspects. Also, in mixed-ability teaching, as is the case in our primary and secondary schools, some pupils are likely to be more motivated by some modes of instruction than by others, even if we may not be prepared to give them such credit, and allow them the choice. Teachers have to learn to live with this reality. If a task has to be performed to fulfil a certain requirement, then it has to be fulfilled, but an allowance should be made for variations in ways of fulfilling it, where ever possible.

> "Educators now generally accept the proposition that there ought to be some differentiation in instruction in the light of the recognized differences in ability, experience and learning styles of the pupils". (Willoughby. 1970. 274)

Teachers in Black education accept the fact of individual differences, but lack the skills of providing for them.

2 THE CLASSIFICATION OF INSTRUCTIONAL MODES

2.1 General

> "Since the beginning of time, man has sought ways of communicating the accumulated knowledge and skills of one generation to another. Some of these methods (modes) have been spectacularly successful in certain time periods, or with certain groups of people, or for certain purposes. The teacher of today can call upon a great variety of methods (modes) to assist in guiding the learning of students". (Alcorn et al. 1970. 139 - the insertion of 'mode' is mine)

Some of the modes used have outlived their usefulness and have been discarded by others who are more confident, but with others who are less confident, some modes are still very much in use, although very much useless. "A threadbare example is the regurgitation method (mode) of memorizing isolated facts, and of repeating inane questions and answers. There are, however, occassions on which both memorization and the question-and-answer method (mode) may appropriately be used in a learning formula". (Ibid) as has already been shown in the previous chapter.

Farrell and Farmer (1980) provide us with the following well-known-but-some-seldom-used modes in Mathematics instruction.

2.2 A discussion of the different instructional modes

2.2.1 The lecture mode

This is the most common mode that most teachers have experienced, and are most comfortable in applying to their teaching. Many are not even able to handle this mode reasonably well. Thus "Lectures at the secondary level have fallen into some disrepute, simply because there have been too many lectures that were poorly done by too many teachers", (Pierce and Lorber. 1977. 93) and since it is, in any case, very hard for most secondary school pupils to remain quiet listeners for long periods of time, "... the lecturer should either keep it short, or be a dynamic lecturer, or both". (Farrell and Farmer. 1980. 7) The poor feedback that teachers, who follow this mode, get, is enough evidence that it is high time they switched to something more productive. The only two advantages the lecture mode seems to have - (1) that of enabling the teacher to present to the pupils a lot of information in a relatively short time, and (2) that of being relatively easy to direct and control - are not good enough for successful Mathematics teaching. It is most disadvantageous to present secondary school pupils with large bodies of information in Mathematics, at one go. The product of the lecture mode, may thus not be the desired one - pupils might not be able to use the information.

> "... unless the pupils do something with the information presented in a lecture their learning and retention is liable to be rather thin".
> (Clark and Starr. 1967. 211)

The highest level to be reached in Mathematics learning is problem solving in a broad sense.

Where problem solving is "... the ability to use previous mathematical learnings (1) to formulate hypotheses and test them, or (2) to prove theorems, or (3) to solve nonroutine problems". (Travers. 1977. 36-37)

The product or capability of problem solving has the indispensable process of generalizing, "... whether in Mathematics or in everyday life". (Farrel and Farmer. 1980. 93). Farrell and Farmer consider the processes and the products of Mathematics teaching and learning to be inseparable. This is a move away from Piaget's and Bruner's process-oriented learning which emphasises the process used to reach a desired product or capability as the most important result of his learning. (Baur and George. 1976). It also is a move away from Gagne's product-oriented learning in which "... the end product or what has been learned, is the most important factor". (Baur and George 1976. 35).

Unless the pupils get involved in the processes of mathematical induction and deduction they cannot fully realise the product of problem-solving. This type of pupil involvement is not imbedded in the lecture mode.

2.2.2 The question/answer mode

2.2.2.1 General

The question/answer mode is another commonly used mode at secondary school level, and needs a lot of skill to provide even minimal success. Asking questions is a science on its own. Hopefully as more is learned about questioning techniques, teachers will be able to use questions effectively.

In combination with other modes "The question/answer mode is extremely valuable as a way to guide developmental thinking, creative problem solving, to initiate discussions and to stimulate quick recall of prerequisites needed for the day's lesson". (Farrel and Farmer. 1980. 8)

Bellman (1974) suggested the following reasons for teachers' inability to practise specific questioning strategy:

> "... teachers do not employ an appropriate questioning technique because they (1) are not familiar with a questioning technique which is relatively easy to implement, (2) have not had training in a questioning technique which is manageable, (3) have little or no evidence that the use of a questioning technique can increase student achievement, and (4) have little or no evidence that the use of a questioning technique can lead to a longer period of retention of knowledge". (Otto and Schuck. 1983. 521)

There are some very useful hints given to help teachers acquire some of the required skills to make the question/answer mode more effective, and these hints should be included in teacher education programs.

2.2.2.2 Do's and don'ts concerning the question/answer mode

Among the do's and don'ts concerning getting responses from the pupils is a factor very often overlooked by teachers - wait-time. "Wait at least five seconds prior to accepting responses to high-level questions. Inform students that you are going to do this". say Farrell and Farmer (1980). Rowe (1973)

"... found that the whole quality of discourse began to change when wait times were increased, and that there was a noticeable change in the children's verbal behaviour". (Rowe. 1978. 209) in her research on the effects of wait-time in science teaching questioning techniques at elementary schools. Gore and Roumagoux carried out a similar study, but, with Mathematics instruction, and, on wait-time as a variable in sex-related differences. "The t test for significance of difference in wait-time for boys and for girls indicated the teachers gave significantly more wait-time to boys than to girls. This difference could possibly have a negative effect on girls' achievement in Mathematics". (Gore and Roumagoux. 1983). This piece of reaearch indicates that most teachers expect boys to do better than girls in subjects like Mathematics and thus do not bother to wait long enough for girls to answer, since they would make mistakes in any case. Most girls know this, unfortunately, and, consequently, live up to their teachers' expectations.

Another suggestion concerns telling the pupils that there will be no penalty for incorrect or partially correct answers, also informing them that the questions are for a learning experience and not a quiz. This is something that most teachers in Black education need to be made aware of - not to use the question/answer mode as a punitive measure, where only those who have given correct responses are allowed to sit down, and the ones who fail to give correct responses might find themselves standing through the whole period. We should remember that :-

> "... questioning is, by its very nature, threatening to some students. ... (Therefore) It is reasonable to expect teachers to be able to develop question techniques that will not humiliate students who provide incorrect answers". (Pierce and Lorber. 1977.99)

(Travers et al. 1977)

2.2.3 The discussion mode

Discussion means "... student-to-student talk with occasional verbal intervention by the teacher. .... There must be a topic - a question, a problem or a situation in which students can share ideas and compare or contrast views". (Farrell and Farmer. 1980) The teacher should be able to choose a topic suitable for discussion, and before the discussion takes place the teacher should make sure that the required prerequisites are grasped by the students. Students should be divided into groups, and, before the discussion period, be thoroughly briefed on what would be required of them, before they take up their assigned seats. The teacher's role should be that of an overseer, a gentle guide,trying to get all people involved as far as possible, watching out for areas of agreement and disagreement, giving "... verbal and nonverbal praise to individuals and groups for such things as creativity, thoughtfulness, intelligent skepticism, and efficiency". (Ibid). This mode has great potential for positive feedback and it can give the students the confidence they so need for the study of Mathematics in particular.

2.2.4 The demonstration mode

When used in combination with the lecture, the question/answer or laboratory modes, this can be a remarkably effective mode. As the teacher is talking about something, or before he or she asks the students to take up a laboratory activity, showing the students what is being talked about, and how it can be used, clinches the idea even more if not better. To serve its purpose this mode should be used with small groups, where all will be able to see at the same time, and this is not possible with large mixed ability classes, such as occur in Black education.

2.2.5 The laboratory mode

The value of this mode has long been recognized in other subject-matter fields, e.g., science and language laboratories have gained increased popularity at least at university level.

> "The laboratory will not replace any of the classroom activities that we know are essential to good Mathematics teaching, but there are certain concepts that can be taught better through the direct approach used in the laboratory". (Sweet. 1967. 117)

Data collection through the manipulation of equipment or material, in this mode, may be employed to help students " ... reach a generalization, test a conjecture, observe the application of a rule, or learn and practice of a psychomotor skill". (Farrell and Farmer. 1980)

There is a great need for this mode at secondary-school level Mathematics teaching, to give the students, who are basically still in need of a considerable amount of evidence for most of the generalisations they are expected to make. Teachers should look at the individual needs of the students, and not expect all of them to enjoy doing what some call 'kids' stuff'. Many teachers need to teach themselves this mode. There is an overflow of resources from contemporary Mathematics Projects that need to be adapted to meet our local needs.

2.2.6 Individual student projects

"Reports and projects can take on the characteristics of good laboratory activities. They permit students to pursue individual areas of interest". (Travers et al. 1977. 270). Teachers get excellent opportunities to get to know their students better as they learn about their (students') interests, and as they work with them on an individual basis. Students should be given the opportunity to share their project results with other students. This mode is not used in our schools. Yet projects give an opportunity for the promotion of affective objectives.

2.2.7 Audiovisual aids

Since the advent of audiovisual aids, more and more teacher education programmes, involve teachers-to-be being given instruction in the use of audio-visual aids, on reviewing materials for quality and suitability, on how to prepare students for the appreciation of these materials in the study of their subjects. Teachers have to learn not to be dictated to by materials, but should only use them as aids.

How to use audiovisual aids needs a lot of skill and practice. They should only be used for a specific purpose, and not for the sake of using them. Mathematics teachers too, should dispute the general feeling that they "... are not great users of audio-visual aids. We therefore now have to look at the ways of introducing students to the possibilities that this variety of sources offers to the Mathematics teacher". (Wain and Woodrow. 1980. 114). Teachers in Black education need to recognize this.

2.2.8 Supervised practice

"This mode involves having students try to perform some task at their seats or at the chalkboard while the teacher observes their progress and gives help as needed". (Farrell and Farmer. 1980. 5) This is the essence of 'practice makes perfect'. But again, it can be made ineffective by those who carry it out as a ritual. When one enters a Mathematics classroom, especially at the secondary-school level one often finds all pupils busy working out problems in their books, with some called out to the chalkboard, and the teacher going round correcting their work. Often that which is being practiced has not even been fully grasped, or, not even taught. Here, too, is need for skills in supervision.

2.2.9 Homework

"A major purpose of homework assignments is to provide opportunities to sharpen skills, develop understandings, and improve problem-solving abilities". (Travers et al. 1977.204)

It should be impressed on the students that homework is not just for keeping them busy, but for them to attain the goals already mentioned above. Teachers should also refrain from giving too many examples at a time.

This mode creates a lot of controversy. Those who oppose it "..... point out that many students have neither the time nor the environment to complete such assignments". (Pierce and Lorber 1977). They also point out that "... once the student leaves the classroom there is no assurance that he or she will be the one actually doing the assignment". These are very real problems for the majority of Black children, rural or urban. It is better if schools provide study facilities.

"When possible, let students begin work on exercises in class, and don't call it homework!" (Farrell and Farmer. 1980. 23). Feedback will be much improved. This mode, toc requires careful consideration of alternatives and thoughtful planning to be efficient and effective.

3 CONCLUSION

Of the nine modes discussed, Black schools, in general, use the four that have come to be linked with the so-called traditional modes-where the teacher mostly knows it all and the pupils do what they are told or what is expected of them. These four modes are the lecture, the question/answer, supervised practice and homework. All have become rituals carried out by teachers who in the main accept that they do not know it all, and find it difficult to motivate the pupils into successful Mathematics learning.

All four modes, are in the main abstract learning, and may be responsible for the kinds of problems occurring in Mathematics teaching in the secondary school.

Whilst suggesting that we try to upgrade our teachers' confidence in the modes they are familiar with, I recommended a switch over to approaches that would involve more pupil activity at the secondary level. I suggest this, with full recognition of Brownell's study (1968), in which he compared the relative effectiveness of Cuisenaire models, Dienes models and conventional teaching approaches in third-grade classes in Scotland and England and came up with results that suggested that an approach (in teaching any topic in Mathematics) most apt to be effective is the one in which a teacher feels most comfortable and is most able to sell to his or her pupils. (Fey. 1980).

CHAPTER 4

THE USE OF RESOURCES IN THE TEACHING OF STANDARD SIX AND SEVEN MATHEMATICS

CONTENTS

1. ABSTRACT

In the past I held one-day Mathematics workshops for the Alice circuit standards 5, 6, 7, 8, 9 and 10 Mathematics teachers - one during the first semester and another during the second semester. I would conduct a common plenary session on the teaching of a specific section in Mathematics, say Algebra, then split up the group into primary and post-primary sub-groups. Each group would work with cards suitable for the group, within the section dealt with during the plenary session.

Each time I held these combined workshops, I would get requests to: (1) hold more frequent workshops - starting right at the beginning of the year so as to deal with sections before teachers taught them; (2) work out common work schemes for each class - this request was more from the lower class teachers; (3) run similar workshops for the pupils, especially the final year pupils - at least one a term, before their June examinations and before their September trial examinations; (4) include teachers from all primary Mathematics classes - this request came from one of the local inspectors, who always attended the workshops, and who has recently been given the task of having to draw up a Mathematics curriculum for the primary classes; (5) consider making myself available to teachers, on request, to help them out with sections in which they were not quite comfortable.

It has not been possible to meet most of the requests because of my own commitments elsewhere. These requests were made to me, not becauese I am some kind of expert, but because of my having been a teacher around these parts, and having tried to keep contact with the schools through teaching practice and these workshops.

I could, however, not completely avoid the request that I give individual help, as some teachers would occassionally bring some problems to me. They would say they do not know anything of a certain topic which they have to teach, and needed to be

taught this before they could teach it to their pupils. Most of them would not have received any training in Mathematics teaching.

In 1983 I decided to run workshops for the standard 6 and 7 teachers, with the intention of covering the teaching and learning of all the topics included in the combined syllabi of these classes. At the same time, I decided to make a study of how teachers of these classes would take to modes of instruction having a more practical bias than the ones they already are making use of.

The schools invited to participate were the following:

1. AMABHELE HIGH SCHOOL
2. DALUBUHLE JUNIOR SECONDARY SCHOOL
3. GEORGE-MQALO JUNIOR SECONDARY SCHOOL
4. GOBIZEMBE HIGH SCHOOL
5. IKAMVELIHLE JUNIOR SECONDARY SCHOOL
6. ILANGA HIGH SCHOOL
7. IMINGCANGATHELO JUNIOR SECONDARY SCHOOL
8. IMPEY-SIWISA JUNIOR SECONDARY SCHOOL
9. JABAVU HIGH SCHOOL
10. JINGQI JUNIOR SECONDARY SCHOOL
11. LINDANI HIGH SCHOOL
12. MASIZAKHE JUNIOR SECONDARY SCHOOL
13. MPAMBANI-MZIMBA HIGH SCHOOL
14. PHANDULWAZI AGRICULTURAL HIGH SCHOOL
15. SIYABONGA HIGH SCHOOL
16. ZWELIYAZUZA JUNIOR SECONDARY SCHOOL

The original programme follows over-page:-

WORKSHOP PROGRAMME FOR 1983

MATHEMATICS: STANDARD 6 AND 7

ACTIVITY	PARTICIPANTS	TIME	DATE	METHOD OF EVALUATION
1. Classroom management 2. Instructional materials in the following sections ; (a) Graphical representations (b) Concrete Quantities	Standard 6 and 7 teachers from local schools (10)	10h00-16h00	April 21	1. Written questionnaire 2. Construction of materials
3. Number Theory 4. Flow Charts — Instructional materials	Standard 6 and 7 teachers from local schools (13)	10h00-16h00	May 26	1. Written questionnaire 2. Construction of materials
5. Geometry: (a) Triangles (b) Quadrilaterals (c) Tesselation	Standard 6 and 7 teachers from local schools (5)	10h00-16h00	June 9	1. Written questionnaire 2. Construction of materials
6. Algebraic Expressions - Instructional strategies	Standard 6 and 7 teachers from local schools	10h00-16h00	July 21	1. Written questionnaire 2. Construction of materials
7. Ratio, Rate & Proportion- Instructional strategies	Standard 6 and 7 teachers from local schools (13 + 52)	10h00-16h00	August 18	1. Written questionnaire 2. Construction of materials
8. Geometry: Perimeter, Area and Volume	Standard 6 and 7 teachers from local schools	10h00-16h00	September 15	1. Written questionnaire 2. Construction of materials
9. Sets	Standard 6 and 7 teachers from local schools	10h00-16h00	October 6	1. Written questionnaire 2. Construction of materials

2. PROCEDURE

I contacted the new Circuit Inspector - 1983 - and informed him of past programmes, about which he, fortunately, had already been informed. He seemed to show no objection, and encouraged me to continue. I then discussed with him the plans I had for this year, showing him the programme, and requested him and his staff to visit the workshops whenever they wished, to give me their comments and suggestions for improving the service.

After the discussion with the inspector, I sent out an open letter to all 16 schools, informing the Principals, Heads of Mathematics, and the standard 6 and 7 Mathematics teachers of the intended programme for this year. I informed them of the positive feelings of the inspector, and invited the teachers to participate in the programme. I assumed a favourable response from the schools on the grounds that I had worked with them in the past, and had actually been requested by those who attended past workshops to run more frequent workshops in order to cover more work. I had overlooked the high turn-over and, consequently, the possibility of having to deal with a completely different set of teachers. With this new set of teachers I would have to prepare them all over again, to accept my intentions.

3. REPORTS

3.1 The first workshop

3.1.1 Attendance

The first workshop was attended by 10 teachers from 10 schools, 7 of whom taught both standard 6 and 7 classes. I had expected 31 teachers, assuming that each of the 16 schools would send out 2 representatives each, and the one school with only standard 6, would have one representative. I made this assumption on the argument that schools in this area, usually, have 3 standard 6 classes each and

3 standard 7 classes each. Each Mathematics class has 6 periods per week, and most teachers of Mathematics teach other subjects in addition - General Science for instance.

3.1.2 Discussion of classroom management

3.1.2.1 Grouping

After reading a paper on mixed-ability classroom management, emphasising the aspects of planning, organising, directing, and controlling for maximum individualisation and pupil participation, I opened a discussion session on classroom management.

The first question brought up was why all the standard 6s and 7s had to do Mathematics in Black schools - a very good question I thought. In support of this major question were a number of minor related questions and statements:

Teacher A: " Do they all have to do pure Mathematics, when there is such a shortage of qualified Mathematics teachers, and even those who are qualified teach the senior classes?"

Teacher B: " Pupils regard Mathematics as a difficult subject, as a result they fail it."

Teacher C: " Pupils are scared of Mathematics because their mothers and fathers tell them it is a difficult subject to learn. They do not even want to attempt it."

(The "mothers" and "fathers" referred to here are described as those who have done some Mathematics, and who have influenced even those who have not, into thinking the same. The last sentence was explained as meaning that the the pupils are scared of trying out problems set as home-work.)

Teacher D: " I am not able to teach Mathematics as I wish, because of the inadequate facilities - I give insufficient attention to individuals, because of the appalling numbers I have to cope with. The apparatus we used at the training school are not even available at our schools."

Teacher E: " The time for teaching Mathematics is too short and the syllabus too long for a practical approach."

On the question of grouping pupils, the question was " What criteria are to be used if grouping has to be done at all?" Some felt that grouping the fast learners together and the slow learners together would facilitate teaching, giving the teacher more time to concentrate on the slow ones, and allowing the fast ones to work on much more challenging examples in addition to what the other groups would be doing. Others felt that each group should comprise both elements, so that the slow ones could be helped by the fast ones, also to combat intellectual snobbery among the fast learners, and lack of confidence among the slow learners. Others felt that grouping them according to sex would be helpful. This would make the girls participate, they claim. One of them explained this by saying " Only boys are raising their hands when asked questions, and they are generally performing better than the girls." These feelings about boys being better than girls may be explained by the following observation: " In mixed Secondary classes Mathematics teachers direct more of their attention to the boys than the girls." (Noble. 1982). Even though the standard 6 and 7 classes, in the schools in this area, have more girls than boys, and are mostly taught by females, teachers still seem to concentrate more on the boys than on the girls. I have observed this during the teaching practice sessions, and even the student-teachers seem to be prey to this practice. This is one of the factors which lead to girls (more than boys) in White education dropping Mathematics after standard 7. (Oberholtzer. 1984) In Black schools, however, it seems that more girls (than boys) continue to take Mathematics, even after standard 7, and continue to do badly. This needs investigation.

Statistics concerning boy-girl ratio in the classes of the 10 teachers who came to the first workshop are shown over-page:

TEACHER	STANDARD 6		STANDARD 7	
	BOYS	GIRLS	BOYS	GIRLS
A	20	20 +	20	45
B	26	45	11	21
C	14	28	16	38
D	12	18	20	23
E	15	19	20	30
F	25	40	20	20 +
G	24	30	20	45
H			34	60
I			40	47
J			44	68

Except for the pairs indicated with a + all other classes have a predominance of girls, and from what teachers tell me, the highest failure rate is among the girls. Yet we see the girls still continuing with some Mathematics of some sort up to the standard 8 level. If they are not doing pure Mathematics, they are doing Functional Mathematics. Functional Mathematics seems to be taught even more poorly than pure Mathematics. Yet those who opt out for Functional Mathematics are usually regarded as the poorest pupils. This needs investigation too.

Although the feelings described were representative of 62,5% (10 schools out of 16) of the schools only, I am fairly certain that they could easily be regarded as being shared by the majority of schools in the area. Teachers just have to acquaint themselves with the different variables within their specific classrooms, and try to shape their instructional strategies accordingly.

3.1.2.2 Teacher self-evaluation

Toward the end of 1982 - September - I had visited the schools in the circuit, and got some teachers to fill in a self-evaluation questionnaire, to get an idea of how teachers interpreted their actions in class. The actions were categorised as follows: (1) teaching for facts and skills; (2) teaching for understanding; (3) teaching for problem solving; (4) teaching for enjoyment and enrichment; (5) classroom management. (Travers et al. 1977)

22 standard 6 and 7 teachers returned the questionnaire. On analysis, the responses concerning the item on the provision of opportunities for individual student participation (classroom management), I found the following data:

N = 22

RESPONSES	TOTAL NUMBER	%
1. Very often	10	45,5
2. Several times	9	40,9
3. A few times	3	13,6
4. Never	0	0.0

This result gives the impression that there is a considerable amount of pupil activity going on at the schools.

When I asked those teachers, who attended, about what types of pupil activity they allowed for, I got responses such as : " We give children classwork and homework everyday"; " We give them opportunities to work problems on the blackboard, but are not able to get all of them to the board before the end of the period"; " Sometimes I ask a bright pupil to teach the other pupils or share a different method of calculating a problem." None saw themselves as not giving pupils opportunities. But when categorising the modes of instruction used here, one sees a heavy bias toward the homework and classwork modes.

Another item under classroom management from which I thought I would be able to get information for conducting the workshops, was the one referring to instructional materials. To the statement " My instructional materials are arranged for easy access when needed," I had the following responses:

N = 22

RESPONSES	TOTAL NUMBER	%
1. Very often	13	59.1
2. Several times	3	13,6
3. A few times	6	27,3
4. Never	0	0,0

According to this result, the approach I wish to introduce in the schools seems to be receiving a lot of attention already. On inquiry, however, I learnt that what teachers meant by materials were their textbooks and chalk, sometimes construction materials such as set squares, protractors, compasses, if they were lucky enough to have these aids. It has also come out that, other than these accepted aids teachers used no other aids in their Mathematics teaching. Pupils, too, seldom possess sets of mathematical instruments.

When I discussed classroom management, I had wanted to bring out the different instructional modes available to the Mathematics teachers, the differences in preferences for these modes the pupils would exhibit, and class management that would try to cater for these different preferences.

3.1.3 Graphical representation and Concrete Quantities

Before getting into a treatment of these, I had intended giving the teachers a questionnaire in which they had to say what problems they and their pupils found with the treatment of these topics. Instead, I embarked on opening a general discussion, since there was a small enough number, to have questions asked and to have a follow-up discussion on answers given.

From this open discussion emanated the general complaint that the teachers are not quite clear about the requirements of the syllabi, and, in most cases, do not quite know what they are expected to do.

I then presented them with the excerpts shown below for further discussion of their complaint.

" C. CONTENT

1. Graphical Representation

Graphs should be regarded as a unifying concept and should not be treated merely as a separate section.

(a) The use, throughout the course, of graphical representation where applicable.

(b) The representation of quantities according to scale by means of two number lines (system of axes)

(c) The graphical representation of statistical data and relations that appear in the syllabus by means of -

(i) Picture graphs (the same shape and size)
(ii) Bar graphs, and
(iii) Line graphs (including curves)

(d) Discussion, interpretation and deductions which follow on graphs drawn as well as those appearing in the press reports.

Averages: Direct calculations from bar graphs.
Simple direct applications.

2. Concrete Quantities (by this is meant concrete objects, e.g. coins to represent Money)

(a) The SI as for everyday use should not be treated as a separate unit but suitable units must be used as in standard five (for standard 6, and standard six, for standard 7)

(b) Concrete quantities must be used in practical examples in all subsections of the syllabus." (The Department of Education and Training. 1980)

These requirements are for both the standard 6 and 7 groups. Both groups confessed that the statements " Graphs should be regarded as a unifying concept and should not be treated merely as a separate section." and " Concrete Quantities must be used in practical examples in all subsections of the syllabus." have them baffled. One teacher said she did not eyen have a syllabus guide, and borrowed mine for a while.

When I asked how they go about teaching these sections then, they said they use the textbooks to guide them, but found some textbooks inadequate in information on graphs and concrete quantities. In fact none of them had used a book that even used the phrase " concrete quantities ". The result is that some would not teach graphs and concrete quantities, hoping that the next teachers in the next classes would teach these sections. Meanwhile the " next " teachers do the same.

After giving an introductory talk on the significance of graphs and the significance of providing the pupils with examples of concrete objects where possible, I furnished the teachers with some work cards as an approach to teaching graphs and " concrete quantities ". This was meant to familiarise them with ways and means of introducing the topics. The teachers responded very favourably. They were even able to add to the different types of data the children could work on. They suggested working with data on the common occurrence of absenteesm per week; headaches and/or stomachaches and so on per week; distances walked to school per child per day; number of funerals per week in the village; age range per family; and so on.

Together we went through the prescribed syllabi for the standard 6 and 7 classes, and the teachers were able to point out the subsections in which they could make use of graphical representations and concrete quantities.

3.2 The second workshop

" Number Theory and Flow Charts "

3.2.1 Attendance

There was an 'improvement ' in attendance. 13 teachers attended this time, and together with the 6 student-teachers taking Mathematics method with me we made up a total of 20. Of the 13 teachers 2 were not teaching Mathematics, but were sent along in preparation for 1984, when they would be given some standard 6 Mathematics classes to teach. They actually were understudies to 2 teachers at the workshop, who would be moving up with their classes in 1984. Just recently I saw one of these 'understudies'in town, and then she told me she was teaching at another school now, and would not have to teach Mathematics in future. She, like many others, must have been frightened by the prospect of having to teach a subject she was not prepared for.

3.2.2 Procedure

I handed out a questionnaire for the teachers to complete, before conducting the the workshop. We then went over the syllabus requirements for these sections.

(a) Flow Charts

The teachers, once again, complained. They complained about not knowing how to go about flow charts, because of the vague manner in which the syllabus guide puts it, and because of the inadequacy of the textbooks they are using. They once again seemed to enjoy working on the work cards I made up, and started making up their own flow charts.

(b) Number Theory

When we got to this section, I listed the problems appearing in the 11 returned questionnaires on the chalkboard for all to see. All of them had put down decimals and vulgar fractions; the four operations on integers; number sentences; indices; six had put down square roots and cube roots; place value; determination of H.C.F. and L.C.M.; percentages; factorisation; three had put down calculations with polynomials; formulae; prime numbers; signs when doing operations.

I gave a brief talk on the importance of numbers in the lives of pupils. Then teachers worked on the materials I had prepared for the day, to see if they could find solutions to some of their problems.

I did not have materials for all the content of the number theory section, but hoped that with the given examples, the teachers would be motivated into exploring possibilities for other content. This they did, but did not have enough time to go through all the prepared cards.

3.3 The third workshop

" Geometry "

3.3.1 Attendance

Despite the fact that I phoned all the schools that have telephones, to remind the teachers of the workshop, this was the most poorly attended workshop. Only five teachers came, and since they were five from the previous workshop, we decided to continue with the previous session's work cards. The teachers requested this as they had not had enough time. The group was only enlarged by my six students. The other teachers, they said, were held up by marking their June examination scripts, and had some deadlines to meet.

3.4 The fourth workshop

3.4.1 Preparation

By this time I had had enough time to reflect on my original programme, and realised that the timing was completely wrong. I also had had quite a number of approaches from the standard 5 teachers, to hold a workshop for them too. I then contacted all the post-primary schools via the circuit office, informing them that the workshop that was to be held on July 21, was postponed to August 18. I informed them that they would share the session with the standard 5 teachers. This information was communicated to the Principals and the standard 5 teachers at the local schools.

3.4.2 Attendance

The attendance was excellent, if not a little too much for the small room I was using. Yet, again, not all the post-primary school teachers attended. There were 13 post-primary school teachers and 2 inspectors from the local circuit.

3.4.3 Procedure

I handed out questionnaires to the teachers for completion, and collected them, telling the teachers that I would only look at the questionnaires after they had worked through the prepared materials. This, I explained, was to let them find out for themselves what materials could solve some of their problems.

After having briefed the participants on the teaching of Mathematics - its general importance - the teachers worked on work cards I had prepared. There was too much work planned for this day. I tried to combine the work that was to have been done on June 9 and July 21, with work of August 18 and September 15. I feared that there would be no audience for September 15, and I had already decided to cancel the work of October 6 - Sets. The present emphasis on sets is on its way out any way.

I then decided to give a general talk on resources - their use in the teaching of Mathematics in particular. I emphasised the point made by Hanson (1975) that:

> " The main factors shaping the resources we use are
> the nature of the students, the subject content,
> and the nature of the learning process itself." (Hanson. 1975. p23)

The aim was not to interest teachers in ready made resources, but to interest them in the raw material and tools available - raw material and tools such as paper, card, glue, plasticine, scissors, tape and so on - for them to make their own resources, express their own ideas and establish their own identities as Mathematics teachers. This expertise should ultimately be transferred to our pupils. Perhaps, I said, it will then not be so easy for us to label our pupils as unresponsive.

I had arranged the work cards and associated materials in themes on the tables for the teachers to move around trying their hands at them, noting down activities that appealed to their individual needs.

Half an hour before the end of the day, we had a session to review the activities of the day. I started off by summarising the problems the teachers had put down in their questionnaires, and asked them to make comments on these, in the light of what had transpired during the 'hands on' session.

The majority claimed that they were now able to view their problems in a different light - that they could through the use of resources try to break through into different teaching methods. Others said they could see the use of the aids and appreciated them, but had not found any work cards on their specific problems, and asked for references on these sections, to try and devise their own resources where possible.

Other important factors which emanated from these discussions will be reported in the next chapter.

4. CONCLUSION

4.1

The teachers who came showed a great keenness in the use of resources, but expressed fears that they might not be able to finish the syllabus if they were to adopt a practical approach all the time. I pointed out to them that the call was not for all their teaching to be along these lines, but for a start to be made in the use of resources, for

> " We may set out as richly laden with resources as 'quinquireme of Nineveh from distant Ophir' , but unless we are confident of sailing in the right direction and with an equally resourcefull response from those upon whom we bestow our wares, we may have laboured in vain." (Hanson. 1975. p59)

4.2

There has been a request for some kind of Mathematics kit.

I am not in favour of a kit in Mathematics teaching in Black schools, but rather for a teacher's manual, that will incorporate the types of materials that can be used in teaching specific topics, and how such materials may be used, such that any teacher can make use of the suggestions, and make the resource material. I feel this will not tie the teachers down in the way a kit would. The use of a kit becomes discontinuous with teacher turnover, it requires the training and retraining of teachers. Kits gather dust, get broken, rust if not serviced, and there is a need for a co-ordinator to keep on looking in on the schools. There is not enough time and man-power for this kind of 'baby-sitting' service, besides, this service needs a lot of dedication, I feel. Also teachers tend not to deviate from the prescribed uses of a kit.

4.3

Teachers also urged me to invite headmasters to these workshops. They maintain some headmasters are not sympathetic to the needs of the mathematics teachers, and that attending these workshops might convert them into appreciating the odds against which the teachers have to function.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

CONTENTS

1. OMISSIONS

Prior to starting these workshops, I had gone round to the schools performing a few Mathematics "tricks" with paper, graph paper, playing cards, die, dominoes, cooldrink straws, ice cream sticks, match boxes, to introduce the teachers to unusual materials in teaching Mathematics. I also carried with me some apparatus such as geostrips, Pythagoras'model, a pocket calculator, Cuisenaire rods and work cards from the SMP. Thus, when I started the workshops, I had the impression that the teachers would take to them with the enthusiasm I was shown by those I met with during my rounds.

When I started to run the workshops, I found there were not as many teachers as I had expected. Some schools never sent any representatives. Yet some of these that never had any representatives, would ask me for help. They would ask me to send all the student-teachers taking Mathematics method with me to their schools during our teaching practice blocks, so that the student-teachers could teach the whole syllabus to their senior classes. Some schools would ask me to come and teach their pupils. Not only do these schools not have teachers to teach their standard 10 classes, but I found that in two schools there were no teachers to teach the standard 6 and 7 classes.

Some definite reasons for the poor turn-out are (1) the high turnover of teachers - some of those who came were not the ones I had seen on my rounds; (2) the fact that I run the workshops at Fort Hare University - some teachers have to travel up to 25Km each way; (3) the fact that all travelling and subsistence expenses are met by the teachers. Another possible reason is that some teachers, who came to the first workshop and stayed away from the others, could have found the modes of instruction emphasised during the sessions rather 'childish' and 'boring'. One lady teacher who holds a JSTC remarked: " The workshop was very well run. I enjoyed the sessions where you gave general talks on how one can approach Algebra and Geometry, but the sessions where we had to work with materials, were more for the primary school." This last sentiment was shared by a representative from head office in Zwelitsha, during a previous workshop. He asked teachers how long they expected to be playing about with the materials I had been suggesting - When were they going to be getting on with the job of teaching? The teachers who were at that workshop kept quiet. I am not sure whether it was because they had no answers, or they had the same question to ask, or whether they had an answer to the contrary but found it hard to say so. Many of them kept on coming to subsequent workshops, however.

One big mistake I made in planning the workshops, was with both the dates and and the days. The April, July and August dates coincided with teacher month end week, and were Thursdays. The last Thursday of the teachers' month is frantically spent with getting marks ready for the Circuit office, as cheques might be with held. The May, June, September and October dates coincided with examinations. Despite all these speculations the August session was the most popular, and had very good results. Future workshops, however, will have to be planned with all these factors in mind.

2. INTERPRETATION OF THE SYLLABUS BY TEACHERS

2.1 Findings

Teachers generally showed ignorance of the syllabus, and greatly relied on text-books, some of which, unfortunately, fall short as teachers' guides. Yet one would want to avoid prescribing a textbook for a teacher. One would rather help teachers in acquiring skills in the selection of suitable texts and references. Some good references are Bell (1978); Clark (1968); Deem (1980) and the National Council of Teachers of Mathematics (1965).

2.2 Recommendations

2.2.1

All teachers should be supplied with syllabi, and heads of division, principals and inspectors should help teachers with the interpretation of syllabi, and the selection of texts. Those responsible for drawing up the syllabi should use clear and unambiguous language.

The remarks under " Introduction " in both the standard 6 and 7 syllabi (they are the same) are quite useful in guiding the teacher with " what " to do. The problem would then be with the " how " and the " why " perhaps. These remarks appear over-page.

2.2.2

Workshops should be run on how to go about achieving the suggested goals.

SYLLABUS FOR MATHEMATICS

STANDARD 7

A. AIM

1. To develop in the pupils an insight into and a grasp of mathematical concepts and methods, thereby assisting them to handle mathematical situations which they meet in everyday life and to solve problems involving quantities and numbers.
2. To help the pupil to develop a logical way of thinking and to set out his work in a systematic and condensed form.
3. To develop in pupils an interest in and appreciation and love for the orderliness of numbers.
4. To prepare the pupils to master calculations which will be required in their study of other school subjects or in further studies.
5. To cultivate in pupils the ability to do calculations accurately and quickly.

B. INTRODUCTION

1. **Remarks**

(a) The arrangement of the content of the syllabus and the subsections thereof is not necessarily an indication of the order which should be followed. As far as possible the various subdivisions should be integrated with one another in the actual teaching. The number of periods is purely an approximate indication of the time that should be spent thereon.

(b) Situations within the experience of the pupils should as far as possible be used as starting points in the study of new concepts.

(c) New concepts should be introduced and based on discovery and discussion and as far as possible should be preceded by practical work and explained by demonstration with practical aids.

(d) With the study of a new concept, all previous principles forming the foundation of the new concept should be thoroughly revised.

(e) Written work should not be attempted before sufficient oral work has been done. The written setting out by the pupil should be short and accurate.

(f) Self-activity where appropriate, for example the drawing up of sums, other approximations with calculations and the collection of data for calculations, should be an integral part of the pattern of work.

(g) Formal drilling purely for the sake of memorising should not be practised. Repetition and consolidation must be done but only by creating new and different situations. The necessary oral and written exercises, judiciously chosen, should be given regularly to improve ability to work with figures and determining various mathematical steps.

(h) No exercise requiring long and complicated calculations should be set.

(i) Pupils should be taught to develop the habit

  (a) of determining by estimation or inspection whether their answers to calculations are within the limites of possibility, and

  (b) of testing answers where possible by inverse calculations.

(j) At the correct stage of their development pupils should be made conscious of the fact that accuracy in figure work goes together with a rapid thought process and a rapid completion of the calculation.

(k) Special stress should be laid at all stages on condensed and orderly setting out.

(l) Calculations necessary for a sum should as far as possible be an integral part of the sum. Where a working column is used, the teacher must insist on systematic and neat work.

(m) The use of algebraic methods should be encouraged, e.g. $8 + a = 13$.

(n) Differentiated instruction should be applied to take into account various ability groups.

(o) When a pupil's intelligence justifies it, his progress should not be limited by the confines of the teaching matter. Rapid workers should be given more advanced calculations.

(p) Mechanical calculations must not be considered as an object in themselves, but throughout be regarded purely as a means of handling arithmetical situations.

(q) Classes should be grouped where possible for project work, e.g. collecting the information necessary to find the area of a garden, the average age of the pupils in a group, etc.

(r) The following themes should be used throughout:

  (a) Appropriate SI-units (Système International. This is the decimal system used in South Africa).

  (b) Graphical representation

  (c) Set nomenclature

  (d) Number patterns

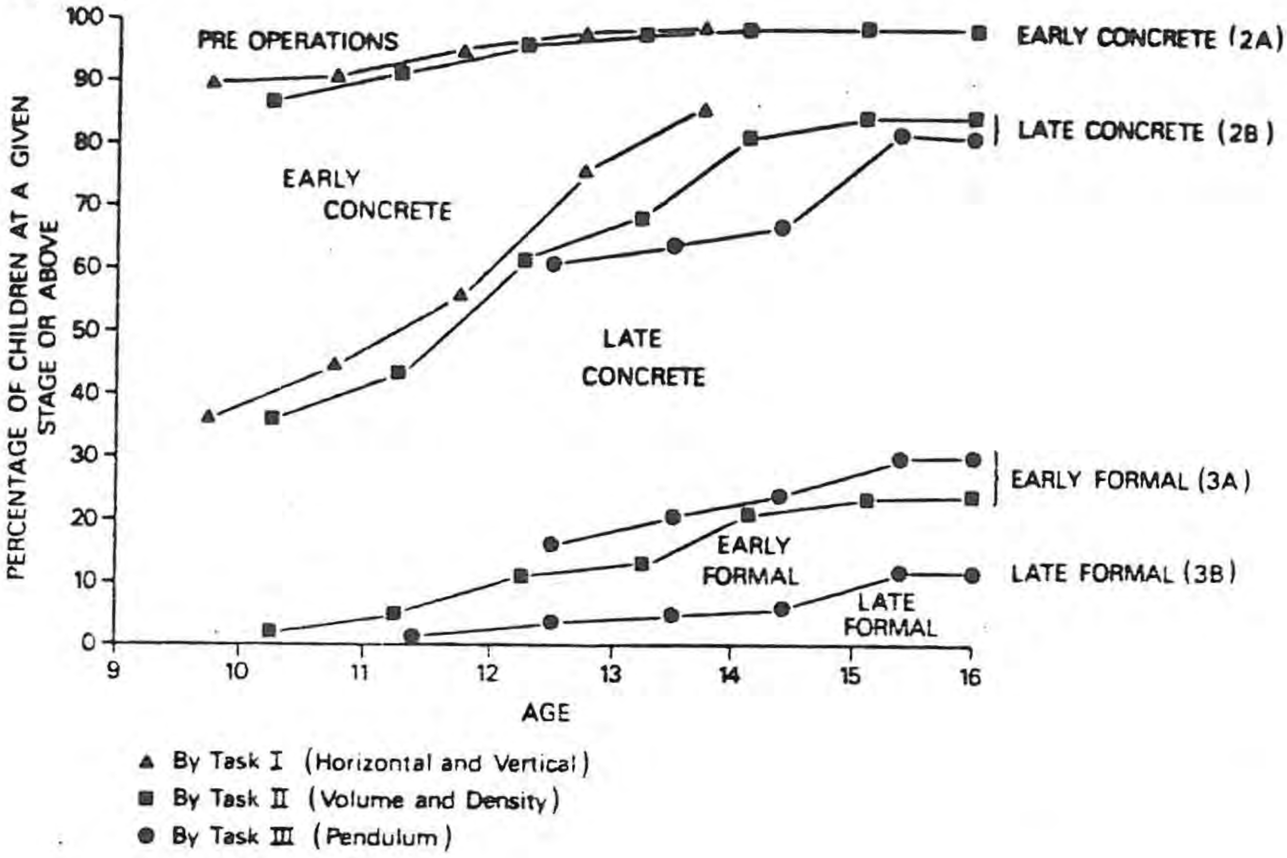
3. THE SEQUENCING OF WORK

3.1 Findings

Many teachers complained about the lengthy syllabus, large classes, and other demands that made it impossible for them to teach any section with any success. This complaint came out most strongly during the joint session. Fortunately we had two inspectors with us, and I asked them to comment on these complaints. One of them said that the problem of Mathematics teachers in this circuit is that they waste a lot of time going in circles, not knowing how to sequence their work, such that there could be a smooth flow of ideas, one into the other, making a coherent whole for the pupils.

Secondary school pupils are supposed to be at the formal operations stage, according to Piaget. Findings are that, in most cases, they are still very much at the concrete stage, depending on the task. " In particular it has consistently been reported that fewer than 50 per cent of the subjects in samples comprised of young adolescents manifest formal operational thinking. (Tisher, 1971; Dulit, 1972; Tomlinson-Keasy, 1972; Lawson and Nordland, 1976; Lawson, 1977; Martorano, 1977; Roberge and Flexer, 1979; Keating and Clark, 1980.)" (Flexer and Roberge. 1983. p195). Not all children go through the stages predicted by Piaget in quite the same manner. The graph reproduced on the next page is clear evidence of this. The implications are that teachers at Secondary school level should try and use as many concrete examples as possible in their work with their pupils. As soon as the pupils are comfortable enough in the use of these concrete objects, then they can be used to lead up to abstractions.

Figure 18.2



(Floyd. 1979 . 361)

3.2 Recommendations

3.2.1

The best thing to do is to sequence subject matter so that it follows the progression of familiar to abstract for certain sections of the syllabus.

Teachers should be provided with a learning sequence and examples of specific topics that can be taught, following such a sequence. The following sequence suggested by Z.P. Dienes (1972) could be tried out:

INTERACTION WITH THE ENVIRONMENT THROUGH CONCRETE MATERIALS - Free play

↓

THE IDENTIFICATION OF A MATHEMATICAL STRUCTURE BY LIKENING ONE SITUATION TO ANOTHER IN A PRECISE WAY

↓

SPATIAL REPRESENTATION OF STRUCTURES FOR HANDLING THEM, AND THINKING ABOUT THEM.

↓

A DESCRIPTION OF THE IMAGE - WHICH GIVES THE GERMS OF AN AXIOMATIC SYSTEM

↓

THE ESTABLISHMENT OF THE RULES OF THE ' PROOF GAME '- A FORMAL SYSTEM IN WHICH WE ARE ABLE TO PROVE THEOREMS.

Although the arrows are pointing in one direction, I would want to believe that the direction and the amount of time spent, will be dictated by the variables operating in one's specific situation.

Dienes concedes that this sequence is not necessarily followed by even the best of pupils when learning Mathematics, but suggests that it is never-the-less worthwhile to try it. I agree that an endeavour to follow it, even if not to the letter, may prove very helpful.

3.2.2

There is a need for teachers to carry out diagnostic tests to find out what the pupils have learnt about what they have been exposed to. " ... the teacher must analyse the content and its concrete prerequisites, must diagnose the students' intuitive background, and must plan instruction to close the gap between the intuitive and the abstract." (Farrell and Farmer. 1980. p66)

On analysing the section on teaching for facts and skills in the Mathematics teachers self-evaluation questionnaire, I found the following responses to the item " I use diagnostic tests to determine student weaknesses."

N = 22

RESPONSES	TOTAL NUMBER	%
1. Very often	8	36,4
2. Several times	12	54,5
3. A few times	2	9,1
4. Never	0	0,0

This did not tally with the general complaint that there just was not enough time to carry out diagnostic tests. Tests carried out are for the record, so that teachers may get their salaries at the end of the month. It is not easy to go over work already done, for remedial purposes, as there is a deadline to be met for the completion of the syllabus.

Another problem with diagnostic procedures surfaced when I asked teachers whether they first found out "where" their pupils "are" at the beginning of a year, before going on with teaching the prescribed content for that class. After the usual reaction of blaming one another for not doing the job, the teachers decided to be more constructive.

One Primary school teacher pleaded for help, saying that he could not say that his pupils were stupid, nor could he say that they lacked the foundations. He said he just did not know some of the content he was supposed to teach, and could therefore not teach it.

Another Secondary school teacher admitted that he did not bother to find out what content his pupils should have learnt before coming to him, and, therefore never bothered about closing any gaps.

Yet another blamed the lack of cooperation among teachers; teachers teaching at the same schools on the one hand, and teachers teaching at different schools but in the same vicinity, on the other hand. She pleaded for team work. She also asked teachers to refrain from being individualistic, rejoicing over each other's failures with the same pupils they are responsible for, rather than clubbing together toward the success of all.

These discussions have very great implications for the future of Mathematics. For one thing, teamwork is a possible way of achieving ends which would otherwise remain dreams. Watson has the following encouraging words to say to the teachers:

> " ... if teachers are to be active participants in curriculum development, rather than the passive recipients of course action prescribed by authority, they must be willing to probe, to question and examine their own teaching, their objectives and strategies, prepared to keep abreast of new developments and learn from the experience of others, constantly rethinking the teaching of mathematics in their own circumstances."
> (Watson. 1976. p5)

4. THE PIAGETIAN THEORY

4.1 Findings

I found that the majority of teachers attending the workshops, did not know Piagetian theory and its implications for instruction in Mathematics.

4.2 Recommendations

It would be more important for teachers-in-service to have suggestions for some kind of 'ideal'sequence for teaching Mathematics to their classes, so that maximum learning may be achieved, rather than to have to learn theories per se.

5. THE TEACHERS

5.1 Findings

One head of division I interviewed on what she thought of the enthusiasm of the teachers, had this to say: " They are willing horses really. I honestly cannot accuse them of a lack of enthusiasm. The problem lies with us at the top. Some of these poor teachers only have the enthusiasm, but not the knowledge of the content." (By " at the top " she means those in authority:- heads of division, headmasters, inspectors, and so on.)

The same head of division remarked about the amount of information available to today's Secondary school pupil. To quote her, she said: " These children know much more than we knew, in these standards, during our time. You and I who have gone to University, might be able to teach them, with some comfort, but what about those poor teachers, who have only gone as far as matriculation?"

None of the teachers who attended the workshops have gone beyond matriculation Mathematics.

5.2 Recommendations

5.2.1

If it cannot be avoided having teachers with inadequate qualifications teaching the standard 6s and 7s, circuits should seriously consider setting up teacher centres within each circuit, where teachers could get at resources, and where workshops could be arranged for them on an ongoing basis. They seem to like working with materials.

To have one in-service training centre in some remote place - only accessible to some and not to others - solves only the problems of those near it. Hlaziya In-Service Training Centre, in Mdantsane, will never solve all the problems of the schools of Ciskei. Teachers attending in-service courses there, waste more time going there, and what is more their classes suffer, as there usually is no arrangement for substitution during these periods.

5.2.2

The introduction of subject inspectors, rather than general inspectors, would be a great help. I have found that it is not only the teacher who gets frustrated by an inspector who is no specialist in the subject he or she is supposed to be supervising during inspections, but the inspector too, does get frustrated.

5.2.3

Team teaching of the kind practiced at one of the schools not far from here, could be tried at all the schools.

At a speech and prize-giving ceremony I attended at this school, I heard the Headmaster give the following account: " Inspectors became quite confused this year (1983) when they called for standard 8 subject teachers, and found that for each subject, almost all standard 8 teachers would present themselves. Each one of us is an 'expert'in some section, and this whole year we tried to solve our problems by teaming up this way, and we are hoping for the best ever results in the standard 8 examinations." This is in essence team teaching, which needs further development.

5.2.4

Leave and financial support should be afforded to these teachers to improve their qualifications.

5.2.5

I wish to endorse the following statement: " The Human Sciences Research Council has advised the Government to eliminate sexual discrimination for maths and science teachers and to pay them more than other staff." (Daily Dispatch, Thursday, December 1, 1983 - 27)

6. THE PUPILS

6.1 Findings

Some teachers described their pupils as not being motivated to do Mathematics; as being dull; as being lazy and lacking the right attitude toward Mathematics.

6.2 Recommendations

I recommend they try and use some of the work cards, games and puzzles in teaching their pupils, making use of materials found within the environments of the pupils. They might obviate conditions depicted by the following cartoon:

(City Press, August 7, 1983 - 15)

7. TRIANGULATION

I had invited (besides the circuit inspector and his colleagues) two senior members from the Faculty of Education of Fort Hare, to attend some of the workshops, as independent observers. I had hoped they would be able to give me some helpful feedback, but they always seemed to have something on, when I held the workshops. All I succeeded in getting were their comments to keep the " good work " going. Comments from one of the inspectors, who attended, are included in the Appendix.

CHAPTER 6

SUGGESTIONS FOR FURTHER RESEARCH

CONTENTS

6.1 The use of teaching materials

According to the study I have carried out, teachers in this area are interested in the teaching of Mathematics through the use of materials. Whether the pupils would learn better when this approach is used on them is not known, and will not be known until teachers decide to use this approach on their pupils. On the basis of this, I would like to make the following suggestions for future research:

6.1.1

Analyse the problems experienced by standard 6 and 7 pupils in Mathematics.

6.1.2

Investigate the effect of the use of materials on the standard 6 and 7 pupils.

6.1.3

Investigate the possibility of distance teaching using the radio in conjunction with teaching materials, in much the same way as it is presently being used for language teaching, where each class will have a portable radio. (Young et al. 1980)

6.2 Appropriateness of the medium of instruction

Many teachers complained about the poor understanding of English - the medium of instruction - in their classes. When I probed this, I found them agreeing with me that the problem of communication is not only with English, but also with Xhosa. Children are just not able to express themselves successfully in any one language. They have a smattering of words in all languages they study, and use a variety of words from a variety of languages to convey one sentence. The consensus of opinion is that people - parents and teachers - just seem to have lost sight of the value of conversation in building up the language skills of their youth. There are too many pressures on parents and teachers, so much that little time is given to conversation and discussion. Parents are too involved with work situations, getting home tired and not wanting to be disturbed; likewise teachers are involved with the rat race of "completing the syllabus" by "talking" their way through the syllabus, with the children mostly being passive recipients.

On the basis of the above findings, I want to suggest the following for future research:

6.2.1

Investigate the linguistic skills of the standard 6 and 7 pupils for appropriateness to Mathematics comprehension, and suggest ways of improving them - in English and in Xhosa.

Perhaps a study aiming at

(a) identifying the main problem-areas in using English;

(b) revising the textbooks commonly used in schools (in such a way as to overcome some of the language difficulties; and

(c) realistically attempting to realise the aim of developing English (or Xhosa) through mathematics education should be carried out.

Mrs Ann Rogan (Science Education Project, 1978) had undertaken such a study with particular reference to (1) general vocabulary knowledge; (2) English language construction difficulties and (3) the acquisition of essential technical vocabulary. Macdonald and Gilmour (1980) reported that "Ciskei pupils battle to express themselves in English and so teachers often resort to the use of Xhosa to explain ideas". (p.19). They also observed a common problem in Xhosa usage - one word would often be used in more than one context. 'Amandla', for instance, means both 'force' and 'power', two different concepts in English. This example shows how futile an exercise it is then, at times, even to resort to Xhosa for the explanation of concepts.

Reed's study (1978) on language competence in mathematics, gave negative correlations for mathematics attainment versus understanding mathematics texts. For second language users:

> "This would indicate that there is a stage at which language becomes an insignificant factor - at least for high performers in mathematics. If this stage can be identified accurately then that is the time to introduce the second language". (Swaziland. 1979. 50).

Perhaps this is the type of research most urgently needed in Ciskei to decide on when excactly to introduce English as a medium of instruction in the schools.

6.3 Advice to future researchers

Before embarking on any research that would make certain demands - any demands, for that matter - on the teachers in Black education, one would have to thoroughly acquaint oneself with the kinds of demands already made upon them, so as to obviate the problem of divided loyalties. Black teachers function under many constraints and have a tremendous backlog. They need sympathy and support.

APPENDICES

A. Letters to participants

B. Questionnaires

C. A list of some materials

D. Some work cards

E. Triangulation

APPENDIX A

APPENDIX A

University of Fort Hare
Faculty of Education
Department of Didactics and
The Science of Teaching

12 April 1983

TO ALL:
PRINCIPALS
HEADS OF DIVISION(MATHEMATICS)
MATHEMATICS TEACHERS (STANDARD 6 & 7)

Dear Sir

RE - ONE DAY WORKSHOPS FOR STANDARD 6 AND 7 MATHEMATICS TEACHERS

In my small way of trying to help improve the effectiveness of mathematics teaching, especially in the lower classes, I, once again, am inviting your teachers to participate in the one day workshops I am organizing at Fort Hare University.

Find herewith a copy of the programme as it stands for this year for the standard 6 and 7 mathematics teachers.

This information has already been communicated to the Circuit Inspector, who is in favour of it.

As you will notice this year I am trying to meet the popular request of running workshops that will take care of the whole syllabus. This year I plan to run workshops based on the standard 6 and 7 mathematics syllabus only. The other classes will be taken care of during subsequent years, until all classes have had their turn. Then the cycle will be repeated. Otherwise I do not have the time to attend to all in one year.

Looking foreward to seeing your teachers here.

Sincerely

(M. A. Y. JIYA - Mrs)

APPENDIX A

University of Fort Hare
Faculty of Education
Department of Didactics and
The Science of Teaching
Private Bag X 1314
ALICE

18 July 1983

TO ALL:
PRINCIPALS
HEADS OF DIVISION- MATHEMATICS
TEACHERS OF MATHEMATICS - STANDARD 6 AND 7

Dear Sir / Madam

RE - MATHEMATICS WORKSHOP PROGRAMME STANDARDS 6 AND 7 1983

Kindly note that the workshop planned for Thursday, July 21, 1983, will now be carried forward to Thursday, August 18, 1983.

I plan to combine this session with a programme for the Standard 5 Mathematics teachers. By so doing, I hope to give an opportunity for consultation, sharing and comparison for the teachers who teach and those who are taught for, so that all efforts will reinforce one another.

In addition to general discussions on the teaching of Geometry and Algebra in these classes, there will be time set aside for teachers to lay their hands on teaching materials meant to enhance, the process of learning mathematics in these classes.

I would appreciate it if the attached form is completed and sent off to me.

Sincerely

M. A. Y. JIYA

....

NAME OF SCHOOL: ....
ADDRESS: ....
NUMBER OF TEACHERS ATTENDING WORKSHOP:................................
PLEASE COMPLETE AND SEND TO ME AT : P O BOX 213
ALICE (5700)

A P P E N D I X B

MATHEMATICS WORKSHOP QUESTIONNAIRE

Please give your honest opinion(s) to the following questions. These will greatly help in the working out of the best possible programme of improving our mathematics teaching in the schools.
This information will be treated as highly confidential information.

1. What problems do you have with the teaching of............ ?

   (a) ....
   (b) ....
   (c) ....
   (d) ....
   (e) ....

2. What are the difficulties of the children in this section.

   (a) ....
   (b) ....
   (c) ....
   (d) ....
   (e) ....

3. Do you think that this is an important section to teach to the classes you are responsible for? YES / NO ....

4. If you have answered 'YES' to 3 above, what makes you say this?

   ....
   ....
   ....

5. If you have answered 'NO' to 3 above, what makes you say so?

   ....
   ....
   ....

6. What suggestions do you have for the improvement of the teaching of this section?

   ....
   ....
   ....
   ....
   ....
   ....
   ....
   ....
   ....
   ....

MATHEMATICS TEACHERS SELF-EVALUATION

1. The check - list which follows contains statements about mathematics teaching, intended to make you discover/review how you teach the subject. Please answer each question/statement thoughtfully, so that the combination of these responses gives you a good picture of how you teach mathematics. This will be a great help towards finding out how best we could handle the subject.

2. Into the 'boxes' provided put in the number corresponding to the statement that best describes your approach. All responses will be treated confidentially.

SECTION I - TEACHING FOR FACTS AND SKILLS

A. I use diagnostic tests to determine student weaknesses. ☐

1. Very often.
2. Several times.
3. A few times.
4. never

B. I provide the students with practice, either orraly or in writing, on the use of rules or procedures. ☐

1. Very often.
2. Several times.
3. A few times.
4. Never.

C. I provide drill on facts and skills needed for success in subsequent learning. ☐

1. Very often.
2. Several times.
3. A few times.
4. Never.

D. I use new words in classroom discussion so that students become familiar with vocabulary. ☐

1. Very often.
2. Several times.
3. A few times.
4. Never.

SECTION 2 - TEACHING FOR UNDERSTANDING

E. I use oral and written questions during the development of a concept to determine student learning. ☐

1. Very often
2. Several times.
3. A few times.
4. Never.

F. I provide periodic review of class work.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

G. I use teaching methods which assist students to discover answers for themselves.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

H. I use chalkboard diagrams and examples different from those in the text - book to promote understanding rather than recall/ memorisation.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

I. I encourage class participation and allow sufficient time for students to think about their answers before responding.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

J. I teach through the vernacular.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

SECTION 3 - TEACHING FOR PROBLEM SOLVING

K. I ask students to state problems in their own words.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

L. I encourage students to draw or to construct physical models of problem situations.

1. Very often.
2. Several times.
3. A few times.
4. Never.

☐

M. I reinforce the solving of problems in a variety of ways.

1. Very often.
2. Several times.
3. A few times.
4. Never.

N. I attempt to provide problems at the student's own level of achievement

1. Very often.
2. Several times.
3. A few times.
4. Never.

O. I encourage students to guess solutions to problems, then test their guesses.

1. Very often.
2. Several times.
3. A few times.
4. Never.

SECTION 4 - TEACHING FOR ENJOYMENT AND ENRICHMENT

P. I use variety in my presentations: coloured chalk, charts, diagrams, models, etc.

1. Very often.
2. Several times.
3. A few times.
4. Never.

Q. I point out rhythmic, symmetric and harmonic relationships which illustrate mathematics in nature, art, or music.

1. Very often.
2. Several times.
3. S few times.
4. Never.

R. I exhibit in class my own enjoyment of the beauty and power of mathematics.

1. Very often.
2. Several times.
3. A few times.
4. Never.

S. I call attention to applications of mathematics in industry, engineering the sciences, and in the students' daily lives.

1. Very often.
2. Several times.
3. A few times.
4. Never.

SECTION 5 - CLASSROOM MANAGEMENT

T. My writing on the chalkboard is clear and flows logically.

1. Very often.
2. Several times.
3. A few times.
4. Never.

U. My instructional materials are arranged for easy access when needed.

1. Very often.
2. Several times.
3. A few times.
4. Never.

V. I give recognition to individual students by name.

1. Very often.
2. Several times.
3. A few times.
4. Never.

W. My students and I show signs of mutual respect.

1. Very often.
2. Several times.
3. A few times.
4. Never.

X. I provide opportunities for individual student participation.

1. Very often.
2. Several times.
3. A few times.
4. Never.

(Adapted from Travers, 1977)

APPENDIX C

APPENDIX C

A LIST OF SOME MATERIALS

1. Basic materials for construction

Acetate sheets
Boxes (an assortment of sizes)
Cardboard
Chalk (an assortment of colours)
Chart Paper (assortment of colours)
Clay or Putty
Clips (paper)
Cotton
Covers of cans (plastic - all sizes)
Dowels (wooden)
Glues or cements
Graph paper (ruled)
Hammers
Hardboard
Knives
Marbles
Nails
Paper
Pencils
Pens
Pins
Pliers
Rubber Bands
Saws
Sellotape
Scissors
Screws
Screwdrivers
Staples
Straws (cooldrink)
Tacks (thumb)
Tape (masking)
Tape (measuring)
Tins (assortment)
Toothpicks
Tongue depressors or ice cream sticks
Tubes (cardboard) from wax paper rolls, etc.
Wire
Wool (coloured)

APPENDIX C

2. Measuring instruments

Balances
Bottles (assortment of shapes and capacities)
Clocks
Compasses
Eraser (round typewriter) for measuring distances on a map
Hypsometer or clinometer
Jugs (measuring)
Mirror (right angle)
Models of unit areas and volumes; linear vernier
Protractors
Rulers
Stop watches
Tape measure
Theodolites
Thermometers
T - squares
Vernier Calipers or micrometer screw
Weights
Wheel (front bicycle with fork attached for measuring distances around school
Wheel (trundle)

3. Computing aids

Abacus
Adding machine
Electronic pocket calculators
Napiers rods
Nomographs
Slide rules

4. Models

Cone that dissects to illustrate conic sections cylinders, cones and spheres of equal height and radius that can be used to illustrate the volume relationship 3:2:1

1 cm cubes in reasonable numbers
Expansion model. (e.g., $(a+b)^2$)
Prepared transparencies to illustrate congruence, similarity etc. for use with overhead projector where possible (3M company) Pythagoras' model set of models of the 5 regular polyhedrons and various prisms and pyramids (McGraw - Hill Company)
Wall charts (Shell and MATIP)

5. Mathematical games and puzzles
(Mostly available at Toy shops and Book shops)

Bingo (e.g. multiplication)
Checkers
Chess
Construct - o - straws
Cross number puzzles (all operations)
Monopoly
Puzzles (Number sentence, word, etc.,)
Playing cards
Scrabble
Tic - tac - toe
Trinimoes

6. Reference Books - appearing in the Bibliography.

APPENDIX D

WORK CARD 1

(Graphical Prepresentation)

Materials needed: Plasticine or crayons or coloured pencils, paper.

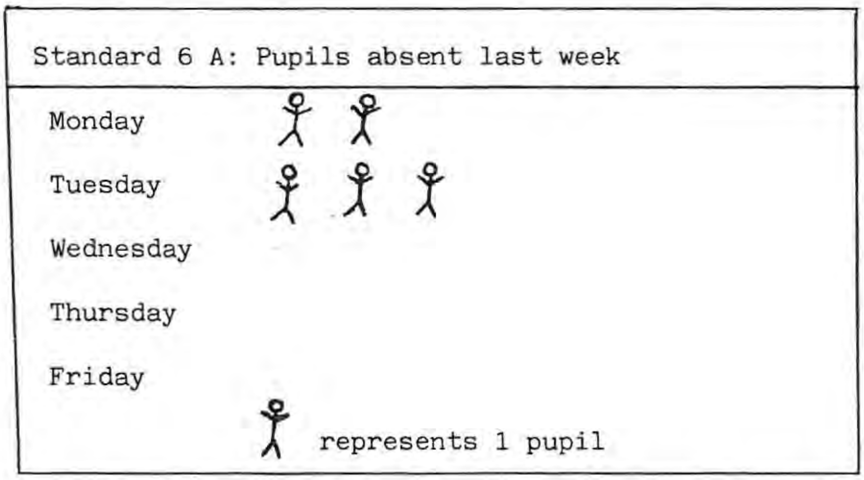
Activities: 1. Look at the table below. It shows pupils absent in Nonceba's class at Yamala Secondary School last week

Day	Mon	Tue	Wed	Thurs	Fri
Number absent	2	3	5	1	7

What day were most pupils absent?

2. Now look at the chart that follows. It shows some of the information from the table above

(a) On a sheet of paper, make a larger copy of the chart below, say 20cm by 15cm. Use plasticine to make the little  . Stick them on your sheet. The figures can also be drawn with coloured pencils or crayons.



(b) Complete the chart to show the rest of the numbers from the table in 1.

The chart you made in 2 is called a pictograph. Can you explain why?

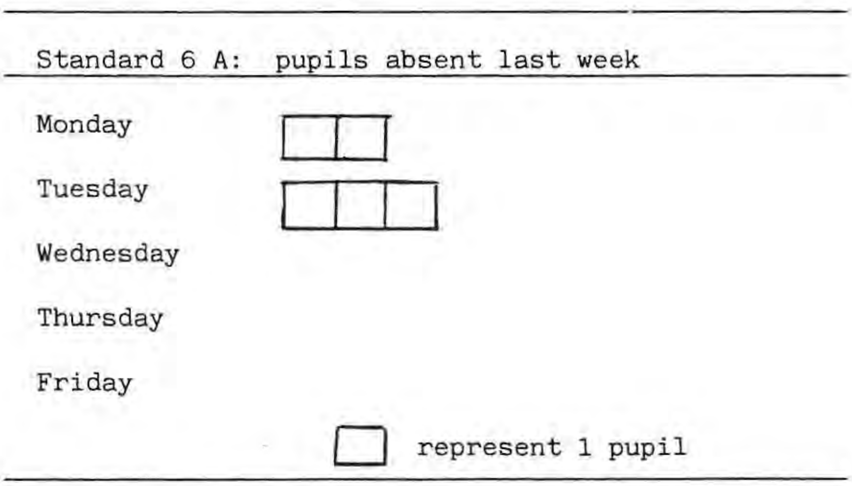
3. 3. Find out the number of pupils absent from your class everyday last week. Show this on a pictograph like the one in 2. Do not forget to write on your pictograph what each  represents.

WORK CARD 2

(Graphical representation)

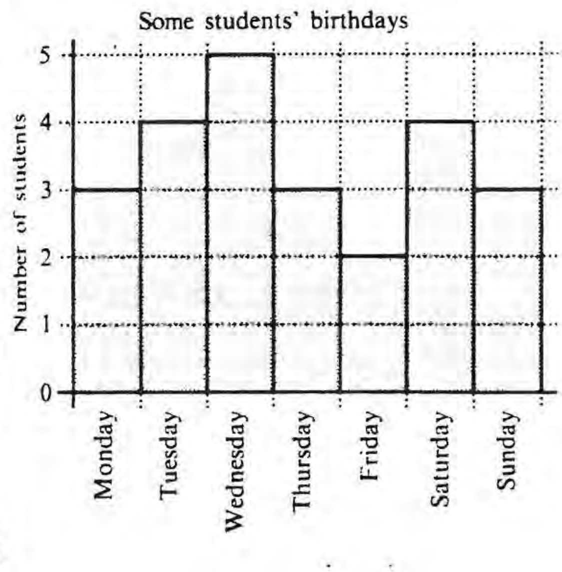
Materials needed: Centimetre squared paper, coloured pencils or crayons, scissors, glue.

Activities: 1. Look again at the pictograph in Work Card 1. Now look at the bar graph below. It shows the same information as the pictograph, but this time a square is used to represent each pupil.



Copy the bar graph above. Cut squares from centimetre squared paper. Use coloured pencils or crayons to colour them. Stick them down on your bar graph to represent the pupils. Complete the bar graph for the rest of the table in Work Card.

2. The next bar graph shows the day of the week on which some pupils have their birthdays this year.



(a) How many pupils have birthdays on a Wednesday?

(b) How many pupils have birthdays on a Sunday?

(c) Which day is the most popular for birthdays?

(d) Can you explain why there is no need to write what each square represents, at the bottom of the graph?

3. (a) Find out the birthday month of each pupil in your class. Fill in a table like the one started below

Birthday month	Number of pupils
January	
February	
March	
April	

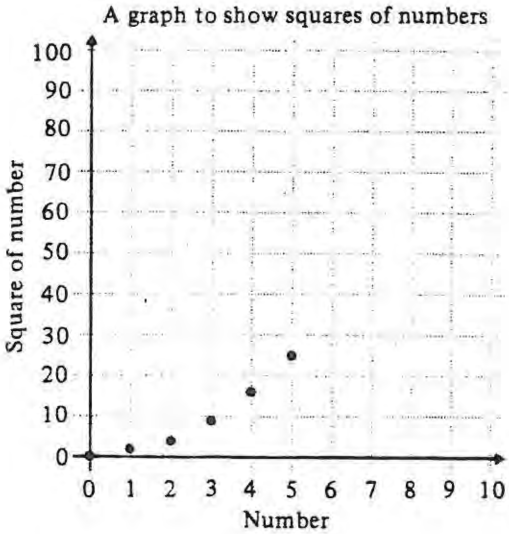
(b) Which month is the most popular for birthdays?

<u>WORK CARD 3</u>

(Using graphs to find square roots)

<u>Materials needed:</u> Graph paper.

<u>Activities:</u> 1. A graph to show squares of numbers.



1 is the square of 1;4 is the square of 2;9 is the square of 3 and so on. Write down the squares of all the numbers from 1 to 10. Show the numbers and their squares on a larger copy of the graph started above. Join the points with a smooth curve.

2. Use your graph from 1 to find (a) $1,5^2$ (b) $3,5^2$ (c) $6,5^2$ (d) $8,5^2$

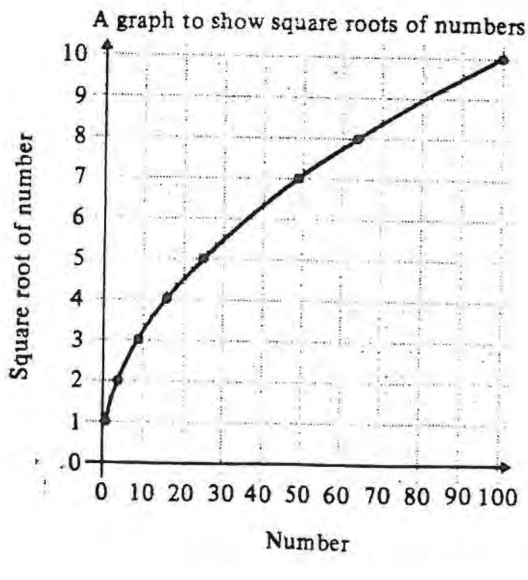
   Check your results by calculation

3. Use your graph from 1 to find the number whose square is: (a) 20 (b) 50 (c) 70 (d) 85

   Work out the square of each of your answers to check how good your results are. Can you improve your graph?

4. Use your graph from 1 to find (a)$\sqrt{30}$ (b)$\sqrt{40}$ (c)$\sqrt{80}$ (d)$\sqrt{55}$

   Check your answers by squaring them.



5. Make a large copy of the graph.

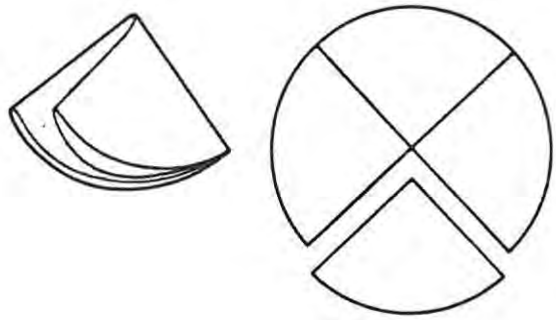
Check the accuracy of your graph by finding:

(a) $\sqrt{36}$ (b) $\sqrt{81}$

WORK CARD 4

(Fractions)

Materials needed: 20 indentical quarter- circles, made from paper or thin card. Using something circular, like the rim of a cup, to help you draw 6 circles, each of diameter about 8 centimetres



Carefully cut out each circle. Fold it evenly in two, again. Cut along the fold lines. This will give you quarter - circles. (Keep the quarter - circles for later use)

Activities : 1. (a) Write a fraction to describe 1 quarter - circle.

(b) Write a fraction to describe 3 quarter - circles

2. 3 quarter - circles can be described as $\frac{3}{4}$ of a circle. How would you describe 7 quarter - circles?

3. Take 7 of your quarter - circles. Put them together to make complete circles. How many complete circles can you make? What fraction of a circle is left over? Did you find you could make 1 complete circle and had $\frac{3}{4}$ of a circle left over?

1 and $\frac{3}{4}$ is written in a short way as $1\frac{3}{4}$. Because it has both a whole number part and a fraction part, it

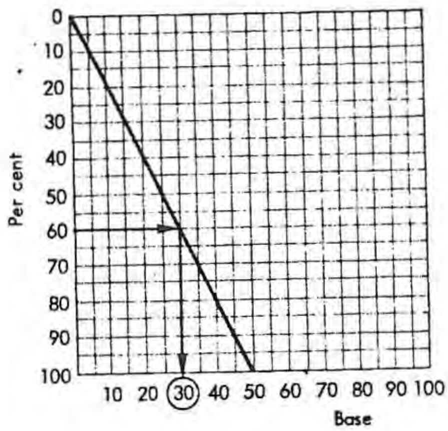
is called a mixed number.

4. Use your paper quarter - circles. Find how many whole circles and fractions of circles can be made from the following number of quarter-circles. Write your answer as a mixed number where possible (a) 1 (b) 2 (c) 3 (d) 4 (e) 5 (f) 6 (g) 7 (h) 8 (i) 9 (j) 10 (k) 11 (j) 12.

WORK CARD 5

(Percentages)

Materials needed: Graph paper, string ruler, thumb tacks, cardboard, glue or paste. Attach a string through a hole at the top of the per cent scale. Make the string long enough so that it can be stretched tightly to any point on the percentage and base scale. Mount sheet with string on cardboard of the same dimensions.



Activities : 1. By properly positioning the string read th. answers to the following. What is 60% of 50? Rate 60%

Base 50

Percentage ?

2. Find a percent given percentage and base. What percentage of 75 is 60?

Base 75

Percentage 60

Per cent ?

3. Find the base given the per cent and percentage

40% of what number is 10?

Per cent	40
Percentage	10
Base	?

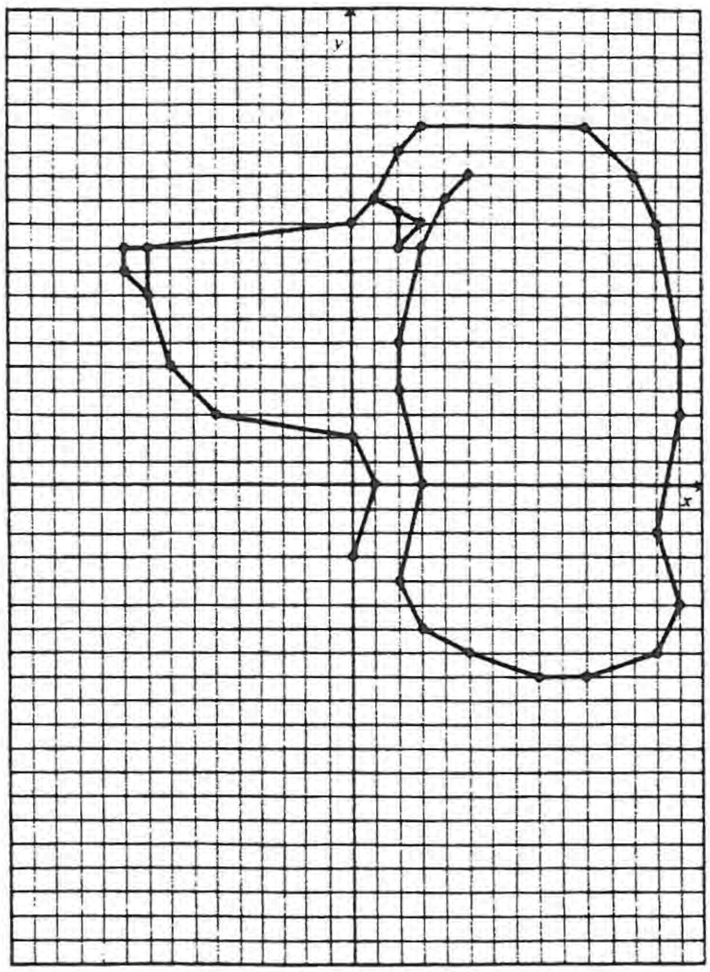
WORK CARD 6

(Equations)

Materials needed : Graph paper

Activities : Find the solution set for each of the equations in the figure below and plot your results.

1. $3x - y = 3$, $0 \leq x \leq 1$
2. $2x + y = 2$, $0 \leq x \leq 1$
3. $y = 15$, $3 \leq x \leq 10$
4. $y = -8$, $8 \leq x \leq 10$
5. $x = -10$, $9 \leq y \leq 10$
6. $y = 10$, $-10 \leq x \leq -9$
7. $x = 2$, $10 \leq y \leq 11.5$
8. $x - 9y = -99$, $-9 \leq x \leq 0$
9. $3x + y = 37$, $13 \leq x \leq 14$
10. $5x + y = 76$, $13 \leq x \leq 14$
11. $5x - y = 67$, $-2 \leq y \leq 3$
12. $\frac{x}{3} - y = 11\frac{1}{3}$, $-8 \leq y \leq -7$
13. $x - y = -8$, $10 \leq y \leq 11$
14. $3x + y = -19$, $-9 \leq x \leq -8$
15. $x = 2$, $4 \leq y \leq 6$
16. $4x - y = 12$, $-4 \leq y \leq 0$
17. $\frac{x}{3} + y = -5\frac{1}{3}$, $-8 \leq y \leq -7$
18. $2x - y = 33$, $-7 \leq y \leq -5$
19. $\frac{x}{2} + y = -\frac{9}{2}$, $-7 \leq y \leq -6$
20. $x + y = -1$, $8 \leq y \leq 9$
21. $2x + y = 37$, $12 \leq x \leq 13$
22. $x + y = 25$, $13 \leq y \leq 15$
23. $x - y = -12$, $14 \leq y \leq 15$



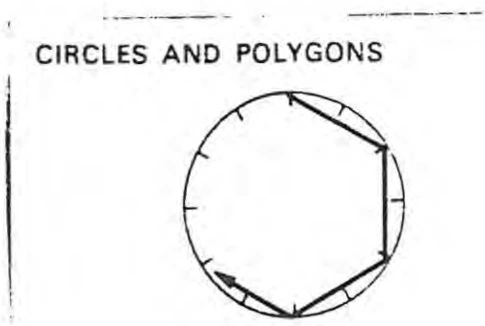
24. $x - y = -11$, $0 \leq x \leq 1$
25. $x - y = -8$, $4 \leq x \leq 5$
26. $\frac{x}{2} + y = \frac{25}{2}$, $1 \leq x \leq 3$
27. $x = -9$, $8 \leq y \leq 10$
28. $x = 14$, $3 \leq y \leq 6$
29. $4x - y = 2$, $2 \leq x \leq 3$
30. $2x + y = 0$, $-6 \leq y \leq -4$
31. $\frac{x}{6} + y = 2$, $-6 \leq x \leq 0$
32. $4x + y = 12$, $2 \leq x \leq 3$
33. $2x - y = -4$, $10 \leq y \leq 12$
34. $x + y = -3$, $-8 \leq x \leq -6$
35. $2x - y = -10$, $1 \leq x \leq 2$

WORK CARD 7

(Circles and Polygons)

Materials needed : Circles with twelve points equally spaced on the circumference

Activities : Starting at any point join the points by straight lines leaving two spaces each time. Carry on until you reach your starting point. (a) What shape have you drawn? (b) For which number of spaces do you reach the starting point after going only once around the circle?



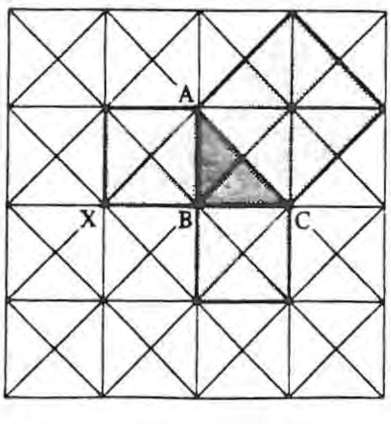
(c) What happens if 3;4 or other numbers of spaces are left?

(d) How many times do you go around the circle for other numbers of spaces?

WORK CARD 8

(Pythagoras' theorem)

Materials needed: Pair of compasses, a protractor, a set square, graph paper, a ruler, and scissors.



Activities: 1. The shapes above have been drawn on a tessellation of small right-angled triangles.

(a) Do you agree that triangle ABC is right-angled?

(b) A square has been drawn on each side of triangle ABC. The area of the square on side AB is equal to 4 small triangles. In the same way, find the areas of the squares on sides BC and AC.

(c) Compare the areas of the squares on the three sides. What do you notice?

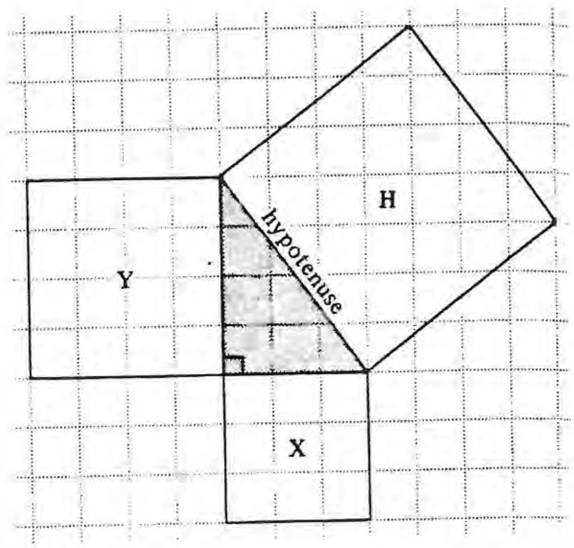
2. Look at triangle XAC in the pattern above.

(a) Do you agree that the angle at A is a right angle?

(b) Do you agree that the squares drawn on sides XA and AC contain 8 small triangles?

(c) Find the area of the square on side XC.

(d) Compare the areas of the three squares on triangle AXC. What do you notice?



3. The shape above has been drawn on squared paper.

(a) Count squares and part squares to find the areas of X, Y, and H. How do you decide which part squares to count?

(b) Compare the three areas. Can you find a relation between them?

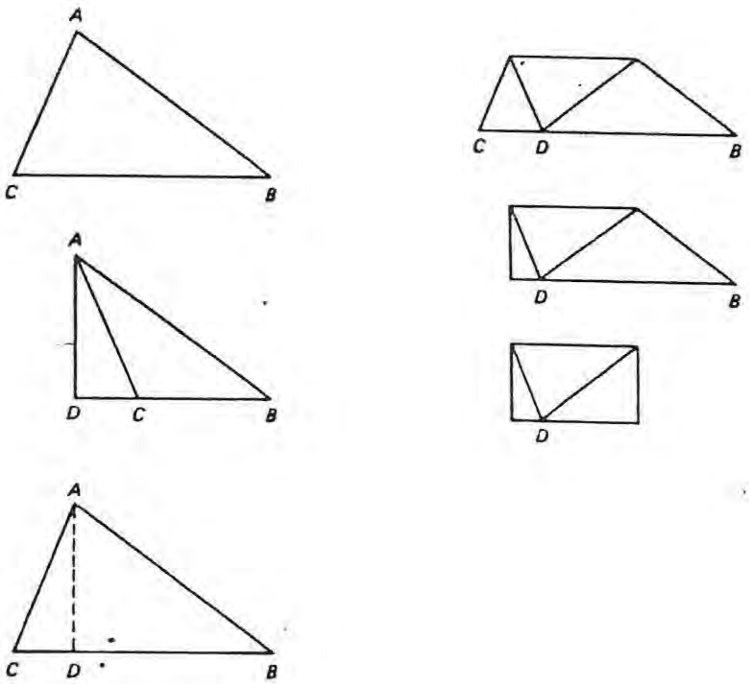
WORK CARD 9

(Paper folding Geometry)

Materials needed : A triangular piece of paper

Activities:

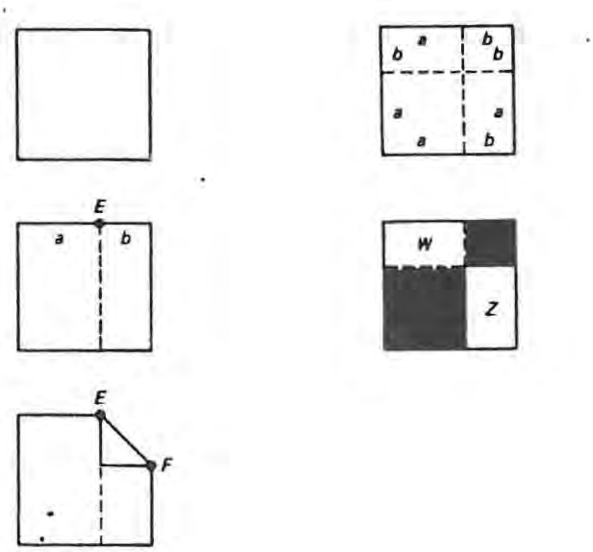
1. Begin with a triangular region ABC.
2. Fold vertex C onto side BC so that the crease passes through vertex A.
3. The crease AD is the altitude through vertex A.
4. Fold vertex A onto point D.
   Fold vertex C onto point D.
   Fold vertex V onto point D.
5. Show that the sum of the measures of the angles A,B, and C is 180°:



WORK CARD 10

(Paper folding Algebra)

Materials needed : One square piece of paper.



Activities:

1. Begin with a square sheet of paper.
2. Fold one edge over at a point E to form a vertical crease parallel to the edge. Label the longer and shorter dimensions a and b.
3. Fold the upper right-hand corner over onto the crease to locate point F. Folding this way, point F will be the same distance from the corner as point E.
4. Now fold a horizontal crease through F and label all outside dimensions.
5. Note that two square regions and two rectangular regions are formed

   area of square Y : a^2

   area of square X : b^2

   area of rectangle W : ab

   area of rectangle Z ; ab

6. Show that these areas together must equal $(a + b)^2$

WORK CARD 11

MULTIPLICATION ROLL

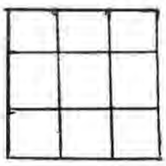
Players : 2

Materials Needed: 3 dice; score card; markers. Each player has a score card and 9 markers.

Object : To be the first to cover all the numbers on your score card.

Procedure: Players take turns rolling three dice and figuring the product of the numbers showing on the dice. If this product is on his score card, he covers the number with a marker. If a player 'scores' he gets another turn. Players take turns until one card is covered.

A score board:



Score boards may include the following numbers:

1, 2, 3, 4, 5, 6, 8, 9,10, 12, 15, 16, 18, 20, 24, 25, 27, 30, 32, 36, 40, 45, 48, 50, 60, 64, 72, 75, 90, 100, 120, 144, 150, 180,216.

WORK CARD 12

BUILD THE GREATEST SUM

This game has many possibilities. It can be played as:

Build the Greatest Sum

Build the Least Sum

Build the Greatest Difference

Build the Least Difference

Build the Greatest Product

Build the Least Product

Build the Greatest Quotient

Build the least Quotient

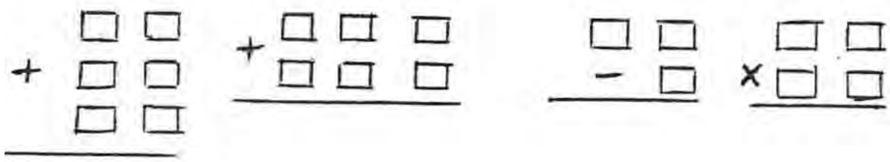
Players : 2 or more

Materials : Deck of cards using the Jokers as zero. Use A - 9: at their face value. Pencils and game mats.

Procedure : Decide which game you are going to play. Shuffle cards. Each player in turn turns over a card and copies that digit into any of his squares. He does not let the other player see his paper. Continue until all the squares are filled. Compute answers and the player who has the answer that best fits the game is the winner.

Or : Turn over cards one at a time and each player uses the same digits. (Here it obviously makes a difference where the digits are placed and requires more strategy). The play is the same.

Some ideas for game mats:



APPENDIX E

IRIPHABLIKI YECISKEI
REPUBLIC OF CISKEI

Irefrensi:
Ref. No. ....

Ifoni:
Telephone: 114 ....

Imibuzo:
Enquiries: Mr B.S. KOPO ....

I-Ofisi ka – Office of the
Inspectors' Office
Ciskei Department of Education
Private Bag X1345
ALICE

ONE DAY MATHEMATICS COURSE HELD AT FORT HARE UNIVERSITY ON 18.8.83

Once again this year, the University of Fort Hare continued to extend its services to the community through the bold and untiring efforts of Mrs Jiya.

The course: (The Background)

1. The rich background portrayed which sort of **placed** Mathematics at the centre of our life on planet earth was of pulsating interest. Expressed in Mrs Jiya's words:- " The relationship between man and his environment forms the basis of Science". Were we to meditate on this statement we would in the end realise how graphically true it is.

2. STRATEGIES FOR THE EFFECTIVE TEACHING OF MATHS

In a nutshell, the futility of teaching Mathematics as divorced from reality was boldly underlined and the following logical steps suggested:-

(a) Interaction with Environment (b) Identification of structures (c) Spatial representation (d) Description of image (e) Establishment of the rules.

3. The Syllabus

Further, the following points in handling the subject were impressively underlined:-

(i) A review of the syllabus (ii) collecting possible activities, (iii) Screening activities (iv) organising activities into a sequence (v) Planning feedback (vi) Checking objectives (vii) Checking motivation (viii) Anticipating safety hazards and organisation problems.

4. SUCCESS OF THE COURSE

All in all, the course was a great success. This is echoed by the enthusiasm of many Maths teachers around Alice to have such courses at least twice a year. i.e. one during the first half and the second one during the last.

5. SUGGESTIONS

(i) In future, courses should be confined to the specific standards instead of grouping both primary and post primary teachers together. Of course the reason for such grouping at the course held on 18.8.83

is clear i.e. Mans Environment and Maths.

(ii) A large variety of aids and the idea behind these

(iii) If possible the running of the course for Sub Standard A and B and the Language.

(iv) Communicating per correspondence with teachers so as to acquaint oneself with their problems and adjust lecture material accordingly.

(v) Organising a feedback from teachers and possibly inspectors.

INSPECTOR OF SCHOOLS
ALICE

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