MORAY HOUSE

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Heriot-Watt University

SCOTTISH CENTRE FOR EDUCATION OVERSEAS

CURRICULUM DEVELOPMENT

An investigation on how the Scottish teachers for V.I. pupils differentiate Mathematics curriculum through flexible and effective methods of teaching and learning and adaptations and modifications, and support to meet the needs of V.I. pupils in integrated mainstream schools, with the view to drawing implications for the situation in Botswana.

By

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This project is presented as part of fulfilment of the requirements of the degree of Bachelor in Education (Honours) Inservice Overseas awarded by Heriot-Watt University.

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DEDICATION

This book is dedicated to my grandfather who died in December 1981 whilst I was expecting my only son Kagiso
ABSTRACT

This study is a small scale investigation of what the teachers of V.I. pupils in Scotland consider as the problems the V.I. pupils encounter in learning Maths and the causes to those problems. Also how they view differentiation of the Mathematics curriculum through flexible and effective methods of teaching and appropriate learning strategies, adaptations and modifications, a good support system and the effective methods of assessment in relation to these children.

The purpose of this research is to gather specific information from the Scottish teachers of V.I. pupils on the above broad mentioned areas with the view to using the findings to cast light on the Botswana situation in order that these implications are made for Botswana.

The approach used for this study is a "small scale research" as it is stated above. Interviews and participant observations, techniques were used to collect this data. The interview questions are both open-ended and structured. For participant observation, structured observation schedules are made. The study of this research is divided into five sections.

In Section One, the Botswana context is viewed, the background to the problem will be explained, the Scottish situation is viewed in this Section for comparison reasons. The aim to this study is also stated. Section Two deals with literature review of related specified areas to the area of study. The research design is explained and the procedures used in gathering data are also described in Section Three. The information which was collected from the research investigation is presented and analysed in Section Four using the qualitative approach. In Section Five, Conclusions which result from the analysis are formulated, implications are discussed and recommendations are made in this Section also.

The findings suggest that the V.I. Specialist teachers and class teachers are jointly working together for the benefit of V.I. pupils. The V.I. Specialist teachers are usually carrying out specialised assessments, in order that they can assist the class teacher to formulate better strategies to use with the V.I. children in their classes. They also showed that there is adequate resource provision.
ACKNOWLEDGEMENTS:

Research of this kind and nature require to be carried out by more than one person. Being the case, the help and appreciation shown by the tutors I have came to know contributed to the completion of this project.

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Finally, I would like to express my deepest sorrow to my husband N. Habangana and our small boy Kagiso for being away from them for the period of two years at the time of happiness and sadness.

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Neo. Habangana-Magogodi
ABBREVIATIONS

SEN - Special Educational Needs
C.T. - Class teachers
V.D.U. - Visual Display Unit
E.A. - Education Authority
V.I. - Visually Impaired
O.E. - Open-ended
ST. - Structured
H/T - Head Teacher
Spec. Educ - Special Education

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SECTION ONE

THE INTRODUCTION

1.1 OVERVIEW

In this section the researcher discusses in broad terms the area of investigation by indicating the context of the study in relation to the situation in Botswana. Comparisons will be drawn between Botswana and Scotland. The researcher will point to the source of the researcher's interest in the topic and show how relevant the topic is to the home situation. In the final analysis, the researcher will clarify the scope of the investigation and describes the expectations drawn from it.

1.2 THE CONTEXT OF THE STUDY

The problem to be investigated is basically a Botswana problem, and has to be seen in that context. The major question is "how can the visually impaired children be best helped to benefit effectively from the Mathematics syllabus?". In the process of investigation the Scottish situation will be used to cast light on the Botswana situation. The problem that is to be investigated is concerned with the teaching of mathematics to visually impaired children in an integrated mainstream classroom in an ordinary primary school. In the experience of this author as a specialist teacher the visually impaired children were not performing well in mathematics as such. This is a matter of common concern in Botswana.

When the author arrived here for studies, it was noted that this was a major concern in Scotland too. Though engaging in discussions with other V.I. specialist teachers and classroom teachers who are directly concerned with
visually impaired children, the author became attracted to the topic as it relates to her major job at home. It would be of help when the author returns home, to work with other specialist teachers for V.I. children to draw up a programme of staff development which will seek to find ways and means of improving the teaching of mathematics to the visually impaired children in Botswana Primary Schools.

In order to understand the context of the study fully, it is necessary to examine the origin of the problem which is basically in Botswana. Now we look at the Botswana situation.

1.3 BACKGROUND TO BOTSWANA SITUATION

The principle of "Education for all" has not yet been reached by the education system of Botswana. This is a perspective which every country should try to work on to meet the needs of all their children.

In Botswana, the provision of education for the visually impaired children is based on the principle of integration, both at primary and secondary levels, irrespective of their abilities, race, ethnic background religion and disabilities. Special education in Botswana is:

"... a fairly new field. However, translated into number of children, this, means that 3500 of the 35000 seven year olds are not attending school because they are disabled"

(Kann, U., Mapolelo, D. and Nleya, P. 1989:64)

Those who are lucky enough to be enrolled in schools,
are expected to go through the national curriculum on a par with their sighted counterparts. The curriculum that is followed is mainly influenced by examinations, that all children have to take at the end of the primary course. The curriculum that is actually implemented by the teachers is called the "effective curriculum", which is the curriculum that:

"consist of those topics and learning objectives that teachers actually teach to students. The effective curriculum stands in contrast to the desired curriculum." (Criterion - reference testing: Rationale for Implementation: Department of Curriculum development and Evaluation, 1992:10)

This kind of curriculum is so designed so that it is rigid in that visually impaired children are made to fit the curriculum instead of the curriculum to meet the needs of these children. Teachers for their part tend to rush children through the curriculum in order to meet the demands of the examinations.

The situation in Botswana, according to the Report of the National Commission on Education (1977:10) "the education system has been slow to respond and at times has actually obstructed progress". This has been noticed too by Kesupile, A.S. (1992:2) in his remarks:

"There is no specific legislation for the education and rehabilitation of the disabled."

Sebeso and Kesupile (1991) note that there are to date 16 units, resource classes and special schools catering for children with disabilities in the three categories
of mental retardation, hearing and visual impairments. Out of 16 resource centres only four resource centres with 2 each for both primary and secondary education are for the visually impaired children.

Pupils are according to Sebeso and Kankamfou (1992:32) are prepared by the resource teachers before they are integrated into the normal classes. Resource teachers (Specialist teachers for V.I. children) also prepare materials and help in remedial work. With other subjects this approach appears to work but in the field of mathematics and science problems abound. For this project the problem is with the teaching of mathematics. In Botswana, teachers would like to be more progressive but are restricted by having to teach for the system because of examination which is a major constraint. The study of mathematics:

"should free children rather than inhibit them."
(Standard Two mathematics Syllabus-Ministry of Education - Botswana 1992)

There are many other constraints that are met in the teaching of mathematics to the visually impaired children and these include
1. Large classes with maximum of 45 pupils
2. Inadequate provision of resources
3. Lack of on-going staff-development
4. Lack of support for both V.I. children and classroom teachers, within the classroom situation.

In terms of the above constraints, the lack of support seems to be a major role, in that:

1. The system lacks national policies to give guidance and this leads to a fragmented service
2. Schools administration seems not to know what it is expected to do in terms of giving clear cut
policies and support to the classroom teachers.
3. The specialist teachers for V.I. children are based in the resource rooms, mainly concerned with transcribing of the materials from print to braille and from braille to print for the visually impaired children, instead of:
(a) giving direct support to both the visually impaired child and teacher in the classroom.
(b) observing V.I. children in the classroom performing tasks with the use of the little residual vision the child might have.
(c) assessing the child's visual functions both formally and informally.
(d) playing a role of advisor and consultant to the classroom teachers to help them have a better understanding on how best they can make the visually impaired child have a full access to the curriculum.

The whole education system as mentioned in (1,2,3) above seems not to be sure of what its role is in connection with the needs of the visually impaired children in that,

1. The curriculum seems to cater for the sighted children
2. Planning at national level is still at trial basis.
3. Provision of special Education is still centrally controlled.
4. Innovations are introduced and implemented without taking into consideration the needs of the visually impaired children and how those innovations will affect their learning.
5. There is no proper co-ordination, collaboration and co-operation among all organisations and departments which cater for educational provision and welfare of children and young people with special educational needs.

In an attempt to search for solutions to the Botswana
situation, the Scottish situation will serve to illuminate the problem. Implications for Botswana can be drawn from the Scottish experience.

1.4 THE SCOTTISH SITUATION

Unlike Botswana, the situation in Scotland is slightly different in that there is a long history of special education. Most of the responsibilities have been devoted to Education Authorities (EA) or to schools. The Education Act (1981) empowers the EA to:

1. Secure adequate and efficient provision of school and further education in their areas for V.I. children.
2. Provide a balanced and all round curriculum.

In addition to those two obligations set above, EAs have special duties and responsibilities. Atherton, G. (1989:22) list the following duties as to:

1. encourage the "early discovery" of children with special need, well before they are due for school.
2. find out what children's special needs are by arranging for children to be expertly assessed.
3. record in the document "record of needs" the child's difficulties and requirements.
4. appoint a named person for parents to turn to for advice.
5. keep watch over a child's special needs.
6. review the future needs of young person.

By law, parents have their responsibilities and rights. Parents are also under legal duty to ensure that their children receive education normally be seeing that they regularly attend school. The children should be educated
according to the wishes of their parents where resources allow.

The school also has legal obligations to ensure that children's educational needs are met. In terms of schools, there are two broad categories, which are:

1. Special schools.

The researcher is mainly interested in children who are integrated in ordinary or mainstream schools were the provision is:

1. Unit provision
2. Resource Centre provision
3. Peripatetic or visiting teacher support for pupils and teachers

Before the children are placed in these schools they go through a process of assessment carried out by representatives of the E.A. viz. Educational Psychologists for the V.I. pupils, ophthalmologist, V.I. Specialist Teachers, etc. After the assessment the children are then placed in the schools with unit, resource centre or through visiting teacher provision, depending on the parents' choice. Many children are now being supported in their respective localities through peripatetic teacher provision support. Chapman and Stone (1989) say that support for the visually impaired in an integrated ordinary mainstream classroom, will much depend on:

"the sheer credibility of special needs teachers, their perceived capacity to offer support and advice and, where necessary, direct, practical help"

The three different levels the teachers of the visually
impaired pupils perform in facilitating V.I. children's learning in an integrated mainstream school are:

1. a "high-profile" where the specialist may sit alongside a pupil with special needs, providing direct assistance and support in participating in activities being followed by the rest of the class.
2. a "low-profile" specialist may join with a colleague in what is in effect a team teaching situation, perhaps spending a little more time with individuals or groups with special needs.
3. An even lower profile is provided by teachers who may not set foot in the classroom at all but who may spend considerable periods of time in discussion with colleagues on ways in which the curriculum can be made more accessible to all children in the class, including the least able. This is an important task.

1.5 AIM OF THIS RESEARCH:

The researcher will focus on the teaching of mathematics in trying to find solutions to the problems that visually impaired children normally meet. The scope of the researcher is to address those issues. The study may be of particular relevance to the situation in Botswana as earlier described. How teachers in Scotland try to solve those problems here will be examined with the hope of trying to find out solutions to the Botswana situations.

The focus of the study will be on trying to find answers to the research questions which are:

1. What problems do visually impaired children usually meet in learning mathematics?

2. Why do they experience these difficulties in mathematics?
3. What is being done in order to help the visually impaired children overcome these problems so that they can draw maximum benefit from mathematics curriculum?

4. What methods and approaches or strategies of teaching, learning and assessment are used to help the visually impaired children to achieve more from mathematics curriculum?

5. What form of support do these children and their teachers receive in terms of materials, specialised equipment, resource and technology?

6. How are teachers assisted to cope with the demands of the special educational needs of the V.I. children in mathematics learning?

7. In addition, the following question will be asked: What role could the preschool provision play in relation to preparing visually impaired children for learning in mathematics?

SUMMARY

This section has looked into the problems that beset Botswana in terms of the provision of the education of the V.I. children. By considering the problems highlighted in the Scottish situation, a range of possible solutions may be illuminated which can be transferred to the Botswana situation.
SECTION TWO

REVIEW OF THE RELATED LITERATURE

2.1 OVERVIEW

The author’s aims in this study are on the teaching of mathematics to visually impaired children and to identify successful curriculum adaptation, modification and modes of support. The main objective of this section is to examine the literature. In the first instance, working definitions, facts and concepts of V.I. children will be viewed in general as they lay down a basis of framework from which the writer will review and examine other aspects related to the research topic. Such aspects include differentiation of the curriculum, mathematics and V.I. learner and assessment procedures. Finally, a summary of this section will be made.

2.2 WORKING DEFINITIONS

Special education needs exist when:

"....any disability (physical, sensory, intellectual, emotional, social, or any combination of those affects learning to the extent that any or all of special access to curriculum, special or modified curriculum, or specially adapted conditions of learning are necessary, if the pupil is to be appropriately and effectively educated. The need may be at any point on a continuum from mild to severe, it may be permanent or temporary phase in the pupils development".

(Brennan, W.K.1985:30)
Special educational needs will require that the education provided is a balanced combination of curriculum, teaching, support and learning conditions necessary to meet the pupils' special educational needs in an appropriate and effective manner. It may form all or part of the pupil's curriculum, may be delivered individually or in association with others, and may be for all or part of the child's primary and secondary schooling.

Other writers or researchers have identified special educational needs as:

"...having learning disabilities significantly greater than the majority of their peers or as having some disability which would prevent them from having their needs fully met without special educational adaptation or modifications to their curriculum."


What the writers are referred to are modifications and adaptations in the curriculum. Before discussing further how these adaptations or modifications are made to fully access the mathematics curriculum to the V.I. pupils, the definitions of the curriculum should be looked at. Various authorities have come up with varied definitions of the curriculum. Tyler (1949) suggested that four fundamental questions should be asked about the curriculum, such as:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organised?

4. How can we determine how these purposes are being attained?

Although the Tyler rationale has not been used since 1949, a series of modifications and improvements have occurred but basis remains the same. This has since culminated into the development of an objective based curriculum, which is:

"essentially a process of breaking down and then building up: Translating broad general aims into a series of short term experiences wherever possible in a helpful sequence; Then by means of a related assessment programme with regular feedback to the learner, the fragments of learning are built up once again into a whole learning experience."

(Lawton, D. 1989:14)

Having looked at what the curriculum is, we then ask ourselves this question, whose curriculum do we refer to? The curriculum is the same for all children including those children, and young people, who have a disability of any form. What is different, is how we access the curriculum to all children, in order that every child is given the opportunity to learn in his or her own level of ability. Through broad terms of special educational needs, the disabled child's educational needs are met in various ways in order that all children are able to achieve set goals. Some of the V.I. children's special educational needs are met in a variety of ways. According to Howart, S.B. (1988) they are to attend either special schools or designated classes or units in mainstream schools. The special considerations which apply to such pupils in respect of the curriculum relate...
1. The general aims of education pursued through the curriculum.
2. The range of the curriculum.
3. The matters of access to the curriculum.
4. The modifications to the curriculum that may be required.

Some of the pupils with special educational needs may possibly be able to follow a mainstream curriculum, if the correct amount and quality of support is provided. The curriculum must be correctly adapted in order to meet the special needs of children who are diagnosed as having such needs. The curriculum would be accessed through modifications, adaptations, and an effective support system. Before looking at how the curriculum should be adapted, or modified and differentiated to give a full access of the mathematics curriculum to the V.I. children, we have to look at who these children are. The children who are the main concern of the research project are the V.I. pupils who are integrated in mainstream primary schools.

2.3 FACTS AND CONCEPTS OF V.I. CHILDREN

There are many definitions of blindness. A number of definitions have been formulated in accordance to the area in which one is operating. From an educational point of view, blindness is interpreted as:

"....total absence of sight." (Best, A.B., 1992:03)

Blindness can also be expressed as:

1. Total blindness, where there is total absence of sight.
2. Partial sight, where there is residual sight which can be utilised.

Blind people have needs and difficulties, which to some extent, are different from those experienced by people with other visual impairment. For example, having to touch to recognise objects, reading and writing in braille, identifying speakers by voice, being dependent on information gained by the use of a white cane for help with mobility. Although in practice, the situation is very much more complex, as some people with partial sight also function as blind people in certain situations e.g. in poor lighting conditions. Many other people will use touch and vision together in their daily lives e.g. to confirm that there is a chair or seat or to establish that their blouse or collar is properly adjusted.

The next question to be asked is, what must be done to help these children draw maximum benefit from the mathematics curriculum in the mainstream schools? A solution seems to lie in the content of the curriculum itself. There have been observations made that V.I. children seem to be performing below the requirements in mathematics. One main reason could be that mathematics like its counterpart, science, has: 

"...a high degree of visual dependency."

(Raffray, M. 1990:95)

It has been noted by some researchers that the progress of many V.I. children is likely to be slower than that of their sighted peers, to a degree that varies with different subjects, and different individual needs. More visually capable children may at first appear to learn at the same pace as less sighted pupils, but
gradually some of them will need a higher level of help to reach their capabilities. So, what can be done to uplift these children with visual impairment, to enable them to operate at their full potential?

The previous section discussed what blindness is and now the writer must examine what other authors have said in relation to how V.I. children's needs are met generally in the curriculum, especially in the area of mathematics. A process of differentiation of the curriculum as a means to meet the V.I. children's needs in integrated mainstream schools will be examined and discussed against what other authors have written on the subject as it relates to the writer's topic.

2.4 DIFFERENTIATION OF THE CURRICULUM

Differentiation can be:

"the process of identifying, with each learner, the most effective strategies for achieving agreed targets."

(Weston, P. 1992)

According to the previous quotation, differentiation would be seen to be:

1. Applied to individuals.
2. Premised on diversity.
3. Multi dimensional.
4. For all learners.
5. Diagnostic.
6. Able to challenge expectations.
7. Able to challenge classroom relationships.
8. An integral aspect of effective learning.
9. Relevant to all teachers.
10. Depend on a long term school strategy.
If differentiation is to work, it should be seen to be appropriately applied in the National Curriculum, so that all children's needs, including those with visual impairment, can effectively be met.

2.4.1 Differentiation and the NATIONAL CURRICULUM GUIDELINES

Moore, J (1992:16) says

"differentiation is synonymous with good teaching."

Differentiation describes how curriculum objectives, content, learning activities, teaching methods and resources are varied to cope with the range of experience of the pupils. In the context of the National Curriculum Guidelines it is about:

1. Enabling pupils of different backgrounds and abilities to demonstrate what they know, understand and are able to do.

2. Ensuring that pupils are given tasks that are commensurate with their levels of ability.

3. Ensuring that pupils achieve success and feel that learning experiences have been worthwhile.

Moore sees good planning as the key to differentiation as he notes,

"Good planning for curriculum support of whole school and key stage or department level will greatly enhance the possibility of efficient curriculum support in the classroom."

Effective planning will involve:

1. Organisation of the units of work: that is translation of National Curriculum programmes of study into units of work.

2. Adapting the material: planning (which provides
strategies for modifying or adapting material generated for the unit of work) in order to meet the specific needs of the groups or individuals.

3. Groupings: That is a variety of strategies for groupings, both within a classroom, and across a key stage or subject area.

4. Support for individuals: the need for planning begins with curriculum support and then progresses through units of work, adaptation of material and groups before finally coming to the individual.

Hall, (1992:20) sees differentiation as a way of matching what teachers require pupils to learn in the curriculum against what pupils bring to their learning, their experiences, knowledge and understandings, attitudes and skills. Hall also sees the important role that assessment plays in differentiation and there are many reasons for undertaking assessment, which are:

1. Clarifying the curriculum.
2. Knowing the pupils.
3. Formative assessment.

Ainscow (1990) acknowledges that differentiations tends to be responding to individual needs. There are three aspects of teaching that seem to be essential in responding successfully to the pupils individual needs which are that:

1. Teachers have to know their pupils in terms of their existing skills and knowledge of their interests and previous experience.
2. Pupils have to be helped to establish a sense of personal meaning about tasks and activities in which they are engaged.
3. Classrooms have to be organised in such a way that encourage involvement and support.

Lewis (1992:24) sees differentiation as:

"a process of adjusting teaching to meet the learning needs of individual children."

In this context, the purpose of differentiation is to promote pupil's success in learning as differentiation is not an end in itself. Differentiation comes in different forms as determined by:

1. Content that is to be learnt.
2. Interest of the children.
3. Pace at which the children operate.
4. Level at which the children operate.
5. Access through a variety of channels.
6. Responses that children are able to make.
7. Sequencing of the material to be learnt.
8. Teaching time (the time the teacher spends with the individual child).
9. Teaching determined by the needs of the individual child.
10. Grouping as seen from activity based or child-centred perspective.

Hunt (1992) warns that there can be wonderful plans on paper, but if the plans cannot be put into action or practice, all the intentions will fall short, and therefore may not be achieved. Time should be spent in carefully planning:

1. Individual programmes.
2. Work in groups.
3. Physical resources.
4. Language and teaching styles.
5. Assessment techniques and procedures.
2.4.2 Warnings Against Differentiation

All along, differentiation has been shown to be the only strategy that can ensure success in providing effective learning to all children with special needs, including those who have visual impairment. Care should be taken in applying differentiation.

Hort (1992) takes a slightly different view of differentiation. A number of possible pitfalls in pursuing differentiation have been noted by the writer, in that, the author argues that focus on differentiation is:

"not only risky but could cause people to overlook a more important opportunity for developing effective responses to special educational needs."

In its present form, differentiation emphasises the differences rather than enhancing teaching and learning to the benefit of all children. The author suggests that what is needed is a way forward which emphasises the links between special educational needs, and the needs of all learners, and uses those links constructively as a resource for improving learning opportunities for all children.

"what children with special educational needs so often require is not something radically different, from other children, but simply what all children need: a better and more rigorous curriculum pursued through a more varied and enlighten pedagogy."

(Hart, S. 1992)

What Hart argues is that the emphasis should not be put onto:

1. Emphasising differentiation to justify separation instead of integration.
2. Labelling children, hence bringing about a stigma because children are quick to spot the provision of differentiation.

3. Emphasis in differences which they are seeking to address.

Hart sees the solutions being in:

1. Evaluation teaching.
2. Responsive teaching.

The area of the curriculum that appears to provide the most difficulties is mathematics, which is now about to be examined. This is the main area of the study.

2.5. MATHEMATICS AND THE VISUALLY IMPAIRED LEARNER

Clamp (1992) notes that children who are visually impaired tend to lag behind their sighted peers. It was noted that the lack of natural visual experiences in basic number awareness limits the opportunities for gaining such number experiences.

This refers to natural environmental experiences from where the concepts of number, size, and proportion are developed. The visually impaired child is likely to have no conception of quantity, sizes and shapes. Taking such concept for granted as for normal sighted children would be unfair. Any Mathematical presentation based on allegedly familiar objects is unlikely to succeed when a child does not have the necessary concepts.

How this can be solved is by approaching the curriculum in a slightly different way. Methods of teaching visually impaired children should be slightly altered from those used for sighted children because:

"....poor mathematical concept development, lack of mathematical understanding, and little experience of specific mathematical topics were the main reason for poor attainment in certain areas"

(Clamp, S 1992: 4)

With a specifically designed programme of mathematics teaching, pupils with visual impairment could achieve standards equivalent to their sighted counterparts.
Visually impaired children can perform reasonably well when materials are adapted to tactile versions or enlarged with good contrast background to suit the child needs. Visually impaired children who use braille are usually slower than sighted children because their speed of information processing is slower than their sighted peers. What is needed according to Clamp (1992) are highly skilled teaching techniques for the visually impaired and that the curriculum is efficiently adapted to meet their needs.

In order that V.I. children from the National Mathematics curriculum the teacher should be aware of:
1. Developing specific skills.
2. Developing dexterity.
3. Selecting appropriate classroom approaches.
4. Employing appropriate teaching methods.

The research shall now look at the specific skills that need to be developed.

2.5.1. Developing Specific Skills

This includes the ability to follow instructions (because V.I. children will not learn incidentally). Self-organisations skills need to be taught in order to develop independence and an efficient use of time. Mathematical equipment, and its use, need to be introduced systematically.

There is a need to establish a proper recording system of the performance and results of tasks.

2.5.2. Developing Manual Dexterity

Clamp (1992:29) states that fine motor skills are crucial for the successful completion of most activities. These need to be developed at all costs if V.I. children are to reach their full capabilities in mathematics.

2.5.3. Selecting Appropriate Classroom Approaches.

Classroom approaches are based on:
1. Suitable experiences where pupils are encouraged to explore new ideas.
2. A firm conceptual understanding of the topic being studied.
3. Flexibility within the hierarchical element of mathematics
4. Exposition of the teacher to both a small group or an individual child.
5. Discussion with pupils in problem solving, investigation, project work, etc.
Appropriate practical work to facilitate the pupils' understanding of mathematical concepts.
In order for skills to be properly acquired by V.I. children, appropriate methods need to be selected and applied.

2.5.4. Teaching Methods.

It is important for the teachers of V.I. children to take into consideration the following points;

1. Forward planning is vital and therefore all work should be prepared well in advance.
2. Physical location of a pupil within the classroom environment is equally important.
3. Experience is preferred wherever possible.
4. Practical tasks will be required at all levels.
5. For topics where tactile representation is necessary for the V.I. pupil, it will be necessary for additional individual input e.g. verbal explanations of diagrams.
6. More accurate verbal discussion on the topics will be required, to compensate for the lack of natural visual mathematical input in the environment.
7. Diagrams in textbooks need to be carefully selected for those pupils who are partially sighted. Diagrams need to be of:
   (a) Appropriate size.
   (b) Clear and uncluttered.
   (c) Simple in definition.
8. Worked examples should be made available to assist with terms of references and samples of tactile/minolta large print diagrams should be produced.

Clamp (1992) attaches great importance to the development of early number work for V.I. children in that the following skills are essential:

1. Developing Classification.
2. Developing seriation.
3. Developing Discrimination.
4. Developing comparison.
5. Developing geometrical concepts.
For all these to take place, the teacher should be able to adapt the materials to suit the needs of visually
impaired children, either in groups or as individuals. There should also be some form of modifications and flexibility wherever possible with a strong support system.

To be most effective, support teaching of all kinds relies on collaboration. Some researchers on classroom support have found out "... teachers sometimes play a secondary role in the classroom, especially where there has been no joint planning of lessons" (Ferguson and Adams 1982)

The classroom teacher and the specialist teacher for V.I. children need to plan together in order that these children may be able to draw the maximum amount of benefit from the curriculum. In general, there seems to be agreement that there are difficulties in establishing good working relationships and that success depends on:

1. Discussion and agreement about the roles and responsibilities of the classroom teacher and support teacher for the V.I. children.
2. Joint planning of learning activities, so that teachers are agreed on the teaching goals and are alerted to likely areas of difficulty for the V.I. pupils.

For effective monitoring of pupil's progress there is the need for an effective assessment procedure, to enhance effective teaching and learning of mathematics.

The success of these methods needs to be tested against the background assessment.

2.6. TESTING AND ASSESSMENT.
According to Clamp (1992:51) and National Guidelines on Assessment 5 -14 programme, great emphasis is placed on assessment. This is done in order to improve the quality of learning and teaching. Mathematics, like any other area of the curriculum has to follow a process of testing and assessment if both the teacher and pupil are able to assess how they are progressing. Assessment is reflected in the following areas:
1. Norm-referenced - where a pupil stands with respect to other pupils who have taken the test.
2. Criterion-referenced - sets out to judge whether or not a pupil has been able to perform some well-defined task to an acceptable standard.
3. Diagnostic test - sets out to classify pupil conceptions and misconceptions.
   These assessment tests could be used either to assess the effectiveness of what has been taught in a single topic or what has been taught in the entire course.

2.7. SUMMARY

From what has been examined, visual impairment affects children who are partially sighted and those that are totally blind. These children are integrated into mainstream schools where they are taught alongside their sighted counterparts. In order for these children to draw maximum benefit from the mathematics curriculum, a process of differentiation is needed to establish where these children are and what their needs are, so that teaching is geared towards meeting the necessary requirements of these children. The process of differentiation is viewed against the background of modifications, adaptations, flexibility and an effective support system within the school. Problems that children meet in mathematics can be diagnosed through a series of assessment tests which are directed towards improving the teaching and learning of mathematics.
SECTION THREE

RESEARCH, DESIGN AND METHODOLOGY

3.1 OVERVIEW

In this section the researcher sets out to describe the research design and the procedures selected for this small scale research project, the rationale for choosing the instruments will be clarified and discussed. The main characteristics and features of the instruments selected will also be discussed. In the final analysis, the limitations and constraints of each instrument used will be highlighted and each instrument’s strengths and weaknesses will be brought to light.

3.2 THE DESIGN OF THE RESEARCH

In the design of this research project two important questions are posed which are:
1. What information is required to be collected?
2. What instruments are used to collect this information?

These questions will set the parameters of which the design will be based. Bell (1987:50) states that when you have finally decided on the topic, refined it and specified its objectives only then you are able to consider what information to collect and how you will collect it. This is shown by the research questions which are:
1. What problems do visually impaired children usually experience in learning mathematics?
2. Why do they experience these difficulties in learning mathematics?
3. What is being done in order to help the visually impaired children overcome these problems so that they can draw maximum benefit from mathematics curriculum?
4. What methods and approaches or strategies of teaching and assessment are used by teachers to help the visually impaired children achieve more from mathematics curriculum?
5. What form of support do these children receive in terms of materials, specialised equipment, resource and technology?
6. How are teachers assisted to cope with the demands of the Special Educational Needs?
7. In addition, the following question will be asked: What role could the preschool provision play in relation to preparing V.I. children for learning in mathematics?

The research questions specify what is needed to be collected. How this information is to be collected is the main concern of this section. Bell (1987) again reminds us that the methods that are used are largely determined by the nature of the information that is required.

The main reason that sparked this desire to undertake this small scale research project is the low performance of V.I. children who are integrated in the mainstream primary school in Botswana. The major reason of doing this research is to find out ways and means of helping these children overcome the problems they encounter in mathematics. When the researcher goes back home she will be able to work with specialist teachers of children with visually impairment in finding out some solutions to this problem.

The information is needed to help to find solutions to this problem will be drawn from Scottish Primary schools heads, specialist teachers for V.I. children, classroom teachers and Regional Educational Advisor for Special Educational Needs. The Scottish experience is used to throw light on the current situation of Botswana.
The problems that Botswana is currently facing are already being tackled in Scotland.

3.3 LIMITATIONS OF THE DESIGN

The research is small scale and therefore has its own limitations in that, the results cannot be generalised. They can only illuminate certain aspects of the problem. The other limitation was the time factor and lack of finance. The number of respondents was kept small because of the time and scale and nature of the project. These limitations had a great influence on the choice of data gathering instruments.

3.4 PROCEDURES FOR COLLECTING DATA

The nature of the information needed determined the kind of instruments that were to be used. In order to get information about what people say they do and what they actually do the following techniques are chosen for this small scale project:

1. Interview
2. Participate observation

3.4.1 THE INTERVIEW TECHNIQUE

Kane (1989:51) remarks that methods of data collection are determined by the nature of information required. One method is used to collect a particular type of information i.e. for what people say they do. The appropriate and useful tool used was Interview Technique, which is

"......a two person conversation initiated by the
interviewer for specific purpose of obtaining research-related information and focused by him on content specified by research objectives of systematic description."

This is a very common research technique, which is favoured by many educationists. A major advantage of the interview is its adaptability. Bell (1988:70)

The Interview Technique was subdivided into two sections which are:
1. Open-ended interviews
2. Structured interviews

First the open-ended interview was tried but did not produce all the required information. It had its own limitations which will be discussed in later paragraphs. This open-ended interview was conducted in one integrated mainstream school The following staff were chosen to be interviewed:
1. Three classroom teachers
2. Three specialist teachers for visually impaired children
3. The headteacher

As mentioned above, the researcher experienced some constraints and limitations in the open-ended interview. Below, the researcher will discuss some of the constraint and limitations brought about by the open-ended interview.

3.4.2 CONSTRAINTS and LIMITATIONS of the OPEN-ENDED INTERVIEW

The open-ended interviews were tried but could not provide all the needed information. The interview was tried in an integrated mainstream school. The reason for not having relied only on the open-ended interviews was that
the respondents did not keep to the specified areas. They tended to wander off or to talk about what they wanted the researcher to know instead of what the researcher wanted. This became clear when the researcher was transcribing information from the tape-recorder. It was then that the researcher decided to use a structured interview schedule in order to keep the respondents to the specific areas. In the structured interviews, the respondents were given a copy of the questions in advance. This was another way of keeping them to the point - unlike what was found with the open-ended interview.

After it had been noted that some vital information could not be obtained through open-ended interviews, more structured interviews were conducted with interview schedules. These sought information on specific areas which the interviewees had to respond to in specific terms. The following were targeted for structured interviews:

1. One headteacher of integrated mainstream school
2. Specialist teachers for V.I. children, who had done through a module on the teaching of mathematics to visually impaired children
3. One Education Advisor for Special Educational Needs (SEN)

The structured interview was an attempt to improve on the open-ended interview. As a result, the researcher felt that a lot of time had been wasted during open-ended interview. That was the biggest limitation experienced. Extra time was still demanded of the interviewees. However, eight out of the ten approached were prepared to be interviewed again.
3.4.3 Participant Observation.

Blythman et al (1989), say classroom observations is a means of:

1. identifying the characteristics of the learner
2. on-going monitoring
3. detecting learning problems as they arise
4. assessing how appropriate the teaching is to learning styles of the pupils
5. assessing the ability of the pupils to transfer skills and knowledge across the curriculum
6. assessing pupils approaches to learning materials and resources.

To discover what the interviewees actually did in practice, the researcher decided to use the participant observation technique. This technique draws information by actually taking part in the activity. Lacey (1976:65) states:

"the transfer of the whole person into an imaginative and emotional experience in which the fieldworker learned to live in and understand the new world."

Bell (1987:88) says that participant observation is more reliable than only relying on what people say they do. It provides an insight into what people actually do. Two major limitations to this technique will be discussed in the next paragraphs. The observation was conducted in two ways:

(a) Direct observation of teachers at work trying to observe how they relate and facilitate effective learning of visually impaired children
(b) Shadowing of the pupils

3.4.4 CONSTRAINTS AND LIMITATIONS OF PARTICIPANT OBSERVATION
There are two major limitations to this technique of participant observation, which are:

1. If the participant observer is familiar with the environment she will tend to take things for granted and miss a fundamental point.
2. If unfamiliar she may tend to be too distant and may miss important aspects that are often picked up by those directly involved in the situation. It is important to establish relations with the subjects to be observed. If proper relations are not established, there will be no proper points of contact.

Another limitation that the technique suffers is one of constructing observation schedules. The participant observer has to know exactly what should be included. The presence of a stranger might change the normal behaviour of the child. The researcher requires to have familiarised herself with the child and the environment. In addition, the technique also lacks a definite system of coding the data observed, therefore it is open to the teacher or researcher to adopt his or her own.

3.5 SUMMARY

The data collected for this research project was done through the use of the two techniques mentioned above. The researcher hoped that the information collected when conducting the research will help her discover the problems that V.I. pupils encounter when learning mathematics, the possible causes of these difficulties and how the professionals who are facilitating the educational provision for the V.I. pupils are trying to resolve these problems.

All the findings will be presented and analysed in the next section. The data will be mainly collected from the interviews and participant observation schedules. As these two techniques are different by nature, the data obtained from them will be analysed separately.
Qualitative approach will be used for both techniques. Qualitative data is more difficult to analyse than quantitative data as it is presented in statistical form.
SECTION FOUR
PRESENTATION AND ANALYSIS OF DATA

4.1 OVERVIEW:

The data collected by interview schedules and participant observation will be presented and analysed in this section viz:

Interview schedules were used to collect data from practitioners in the Scottish Primary Schools named in the previous section. The data is concerned with how to facilitate access to effective learning in the Mathematics curriculum to pupils with visual impairment in their mainstream primary schools. The participant observation was done by shadowing two V.I. pupils. It was geared to yield information about what the teachers do in order that all children benefit from the Mathematics curriculum. Data collected by the two techniques mentioned above will be analysed and presented separately with the view of drawing them together when looking at the research questions. Analysis of these Scottish situations will be viewed at this point. In the next section, implications for the situation in Botswana will be discussed and recommendations made.

The data collected through both open-ended and structured interviews has been categorised into five broad headings (see the Table 4.1.3) below. Putting the data collected under categories will assist coherence and provide a framework to be followed in the analysis and presentation.

Table 4.1.1 shows the distribution of interview questions as related to the five categories and lists the respondents
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>RESPONDENTS</th>
<th>QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Effect of visual impairment</td>
<td>C.T. 1,2</td>
<td>1,2</td>
</tr>
<tr>
<td></td>
<td>V.I.Specialist1,2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H/T 1,2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adviser SEN</td>
<td></td>
</tr>
<tr>
<td>2. Experience</td>
<td>C.T. 8</td>
<td>2(D), 3(D), 9</td>
</tr>
<tr>
<td>(i) home background</td>
<td>V.I. Specialist 8</td>
<td></td>
</tr>
<tr>
<td>(ii) pre school</td>
<td>H/T 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adviser SEN</td>
<td></td>
</tr>
<tr>
<td>3. Methods and approaches of</td>
<td>C.T. 3,4,13</td>
<td>3,4,5,7</td>
</tr>
<tr>
<td>teaching and learning</td>
<td>V.I. Specialist 3,4,13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H/T 3,4,13</td>
<td>1,4</td>
</tr>
<tr>
<td></td>
<td>Adviser SEN</td>
<td>1,4,5</td>
</tr>
<tr>
<td>4. Identification of support/</td>
<td>C.T. 5,6,7,9,10,11,14</td>
<td></td>
</tr>
<tr>
<td>resources for teachers and</td>
<td>V.I.Specialist 5,6,7,9,10,11,14</td>
<td>6,8,10,11,13</td>
</tr>
<tr>
<td>pupils</td>
<td>H/T 5,6,7,9,10,11,14</td>
<td>1,4</td>
</tr>
<tr>
<td></td>
<td>Adviser SEN</td>
<td>1,2,3</td>
</tr>
<tr>
<td>5. Methods of assessment</td>
<td>C.T. 12</td>
<td></td>
</tr>
<tr>
<td>(i) visual functioning</td>
<td>V.I.Specialist 12</td>
<td>12</td>
</tr>
<tr>
<td>(ii) mathematical skills</td>
<td>H/T 12</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Adviser SEN</td>
<td></td>
</tr>
</tbody>
</table>

4.2 EFFECTS OF DEGREE OF VISUAL IMPAIRMENT

In this category, the respondents were classroom teachers, V.I. Specialist teachers and the headteacher. Data was collected from those through open ended and structured interviews. The responses from the classroom teachers and V.I. Specialist are outlined on table 4.1.2 below.
<table>
<thead>
<tr>
<th>CLASSROOM TEACHERS RESPONSES</th>
<th>V.I. SPECIALIST TEACHERS RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nervousness and low self esteem.</td>
<td>1. Not being able to see clearly the materials and displays.</td>
</tr>
<tr>
<td>2. Too much details which confuse the child.</td>
<td>2. Problems involving money concepts and judging distances because of lack of special awareness.</td>
</tr>
<tr>
<td>4. Slowness in practical work and decoding information</td>
<td>4. Poor hands and finger manipulation</td>
</tr>
<tr>
<td>5. Problems with measuring, weighing, time concepts, tens and units etc which are based on vision.</td>
<td>5. Poor hand and eye co-ordination</td>
</tr>
<tr>
<td></td>
<td>6. Degree and nature of visual impairment e.g. nystagmus child has problems with &quot;fixation&quot; while another child with tunnel vision may not be able to perceive a whole shape or picture</td>
</tr>
<tr>
<td></td>
<td>7. Poor teaching and learning strategies</td>
</tr>
<tr>
<td></td>
<td>8. Inability to assess the child's level</td>
</tr>
<tr>
<td></td>
<td>9. Lack of concrete material support e.g. counters, 3 dimensional objects etc.</td>
</tr>
<tr>
<td></td>
<td>10. Inadequate and unclear instructions.</td>
</tr>
<tr>
<td></td>
<td>11. Learning difficulties.</td>
</tr>
<tr>
<td></td>
<td>12. Delay in cognitive, motor and language development</td>
</tr>
</tbody>
</table>

Questions 1 and 2 (see Appendix 1) were related to problems that are being experienced by children with visual impairment. The classroom teachers said children with visual impairment appear nervous. Because they have visual difficulties, they may not understand pre number concepts such as big, bigger, than, more, less, same, different size, shape, quantity etc. therefore they may find difficulties in number conversations and one to one correspondence.
This may in turn result in low self esteem.

Totally blind children learn mainly through hearing and by memorising information. The process becomes tedious when they have to remember too much detailed and concentrated information e.g. using a tactile diagram or graph which may help the child to solve the problems. Many of them get easily confused.

The size of print is another problem for V.I. children. Slowness in practical work and decoding of information are obvious problems for V.I. children because the children with visual impairment especially the blind depend on other senses and memory. The observer made an observation when she was watching a particular V.I. child attempting to identify the number of sides on a cube. The child felt its way around and around the cube. The teacher marked each side as it was counted but it still took a long time for the child to recognise the number of sides on the cube. It is true that practical work takes much longer for the V.I. pupils because handling materials can be problematic also e.g. in measuring or weighing, materials can be mislaid or amounts forgotten as the framework of reference is changing all the time.

On the whole, as the V.I. Specialist teachers have stated, not being able to see clearly may have a bearing on the V.I. pupils learning process. This problem becomes more severe for the totally blind child who has to identify everything through touch. For instance a blind child with poor hand and finger manipulation may not be able to detect easily the Mathematics braille representation dots and the tactile diagrams. The concept of distance is another difficult concept and more complex for the blind children to understand. Most
children learn incidentally, but this seems not to be the case with V.I. Children, especially the blind who need to learn the same things by structured experiences.

The degree and type of visual impairment and lack of experience and incidental learning are regarded as the main causes of difficulties in Mathematics for the V.I. children. Some visual impairments have the effects that the child may not be able to perceive a whole picture or an object, for instance, a child with tunnel vision would have limited field of vision. Therefore, the child is likely not to perceive and form the whole picture on the retina unless certain strategies and low vision aids are used. In other conditions such as nystagmus, "fixation" may be a problem because of involuntary movement of the eyes. Therefore the V.I. child may need to be taught systematically what sighted children learn incidentally. They may encounter delays in language, cognitive and motor skills, which will in turn cause learning difficulties or poor self esteem.

Methods of teaching and learning which do not take into account problems experienced by V.I. children have been cited as adding to the difficulties these children are faced with in learning Mathematical skills. This will be dealt with in the next section on Methods and Strategies of Teaching V.I. Pupils.

Having asked the head teacher the questions 1 and 2 (Appendix 1) it was quickly discovered that she was unfamiliar with the day to day problems experienced by V.I. pupils and their teachers, and appeared more concerned with organisation and resourcing. The researcher had to design a different structured interview
which was tried with the head teacher of another integrated mainstream school.

4.3 EXPERIENCE

(1) Home Background
(2) Pre-School

In this category respondents were classroom teachers, V.I. Specialist Teachers and the head teacher. Question (8) (Appendix 1) asked them to state the importance of home background experience and pre-school education in relation to the V.I. children. Their responses were:

1. Based on whole concept of playing with materials, ordering, sorting and classifying.
2. It is important that V.I. children where possible are given practical experiences e.g. shopping, measuring speed, depth etc.
3. Child's visual impairment may be identified at early age, which will lead to early diagnosis and assessment of the vision.
4. Children from more deprived backgrounds will require much more structured practical experience.
5. There are a lot of counting activities (to form basic number concepts) through songs, rymes, plays, etc.
6. Intervention begins in pre-school with activities such as the following:
   material handling e.g. bricks, clay, plasticine, play dough.
7. Identifying colours, grouping red, yellow, blue objects, sorting shapes like squares, triangles, circles etc;
   Identifying small, large, big, little, heavy, light
etc and sorting them into sets.

The V.I. children need to be offered priority placements in pre-school education. This is likely to help them because they may get individual attention on specific structured play. The teacher will use observation techniques and record her observations carefully. She will then be able to identify the child's level of development and the strengths and weaknesses. The teachers will identify the child's level of development from where the child is by observing all the time. Ongoing records of the child's development and progress can be kept. Early identification of visual impairment may be possible in that if the child's eye condition needed an operation doctors would be able to do that as early as possible to avoid further complications.

Children arrive at nursery school with a range of experiences. These may be determined by a variety of factors i.e. type of home background, type of parent and type of disability e.g. visual impairment. Nursery school must compensate for children who have been over protected and those who come from deprived home backgrounds. The aims of nursery school are to produce independent learners and this is no different for children with visual impairment.

The headteacher's response to question (8) (see Appendix 1) on the importance of pre-school she said "although a provision for pre-school education is difficult to get for the V.I. pupils it plays a vital role e.g. for socialisation reasons". Socialising for V.I. pupils is a problem. The classroom and V.I. Specialist teachers realised the importance of pre-school education on preparation for learning and the head teacher saw the main priority as social interaction.
4.4 METHODS APPROACHES AND STRATEGIES OF TEACHING THE V.I. PUPILS:

Questions 3, 4 and 13 (see Appendix I) asked the classroom teachers, V.I. Specialist teachers, the headteachers and Adviser-SEN to state and describe what methods, approaches and strategies they use in teaching Mathematics to V.I. pupils. See the table below for their responses:

Table 4.3.1: Gives responses of the class teachers and V.I. Specialist teachers on the methods, approaches and strategies of teaching mathematics to V.I. pupils

<table>
<thead>
<tr>
<th>CLASSROOM TEACHERS</th>
<th>V.I. Specialist Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Give as many objects as possible to touch.</td>
<td>1. V.I. children should be helped to handle three dimensional objects.</td>
</tr>
<tr>
<td>2. Give extra help if needed.</td>
<td>2. Observe the child and anticipate where the problem could be.</td>
</tr>
<tr>
<td>3. Give more individual attention.</td>
<td>3. Adapt the materials if necessary.</td>
</tr>
<tr>
<td>4. Give practical help.</td>
<td>4. For counting use concrete objects like blocks.</td>
</tr>
<tr>
<td>5. Work in small groups.</td>
<td>5. Use contrasting colours for partially sighted children.</td>
</tr>
<tr>
<td>6. Increase teacher/pupil contact time</td>
<td>6. Work closely with the class teacher to pinpoint the most difficult problems to V.I. children.</td>
</tr>
<tr>
<td>7. Copy sums for the children and allow them to write in answers.</td>
<td>7. Make sure instructions are clear and brief and do not take things for granted.</td>
</tr>
<tr>
<td>8. Organise learning materials properly.</td>
<td>8. Find the child's level of attainment.</td>
</tr>
<tr>
<td>9. Let pupils rest if they are tired.</td>
<td>Teachers methods of teaching should be flexible in order to meet individual children's needs.</td>
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<td></td>
<td>10. Direct support in the classroom may be required.</td>
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<td></td>
<td>11. Classroom organisation is important in that the child must know where to get Braille materials and other things.</td>
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<tr>
<td></td>
<td>12. Learning materials must be produced with the view to address each individual child's needs e.g. Braille textbooks.</td>
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textbooks, work sheets, tactile diagrams, large print size etc.
13. Materials should be prepared well in advance.
14. Extra time is needed

The mainstream teachers suggested that extra help, practical help, individual attention, working in small groups and increase teacher/pupil contact time are necessary. The lengthy periods of work may tire the V.I. pupils so work should be presented in suitable amounts.

V.I. Specialist teachers felt that V.I. pupils should be allowed to handle three dimensional shapes, be observed and assessed to find out their needs, and that the material should be adapted to meet those needs. They recommended the use of specific things/concrete objects rather than abstract concepts. Contrasting colours for partially sighted children to be used also. Teachers are expected to give instructions which are clear and brief.

It seems that the classroom teachers would like to do things for these pupils while V.I. Specialist teachers aim to foster independence in the V.I. child. They are trying to find out the children's ability to perform a task whereas classroom teachers seem to give more assistance even where it is not necessary. The Specialist Teachers will assess a pupil's need for a Low Vision Aid such as a C.C.T.V. or magnifier. Classroom organisation was also considered very important in that the child should know where necessary materials are kept e.g. braille papers. An orderly classroom is an important asset to V.I. pupils.

The V.I. Specialist Teachers suggest that pupils should be given extra time to complete the task and classroom teachers suggest that they should be left to rest if they are tired.
The headteachers' responses to set of questions 3, 4 and 13, and 1 and 4 (see Appendix 1 and 3) were different in the sense that the questions were asked differently to them. One headteacher's response was that she did not have any direct involvement with the implementation of Mathematics curriculum to the V.I. pupils. Rather, her involvement was more to do with monitoring, supervising and facilitating the childrens' needs in relation to the 5-14 Curriculum guidelines. The head teacher consults the staff whenever there is a point to be discussed which is related to the V.I. pupils in the school. The head teacher said she relied more on the V.I. Specialist teachers for effective methods of teaching these children in the classrooms.

Another headteacher was asked a question which was related to policy document for the V.I. pupils in the school. The main interest the researcher had when asking this question was to know what the policy document stated in relation to teachers and other childrens' attitudes. The headteacher's response was that she didn't have any policy document for the V.I. children in the school since the school had only one V.I. child. Thereafter the headteacher said the teachers and other children's attitudes were not a problem at all to that V.I. child. The headteacher said other children were used to this child so there was no problem with social interaction. Another question requested the same headteacher to state methods and approaches of teaching he would suggest or recommend to the classroom teacher in regard to teaching Mathematics to this V.I. child. The response was that he would advise the classroom teacher to:

1. Enlarge the print size for the child.
2. Make sure the child used his (V.D.U.) specialised equipment appropriately and in an effective manner.
3. Make sure that both of them (the classroom teacher
herself and the auxiliary teacher should work cooperatively for the benefit of the child. The classroom auxiliary should know what is expected of her in relation to the helping of the child in the classroom.

The Adviser for SEN had different interview questions. Questions, 3, 4 and 5 (see Appendix 4) asked her what advice she would give to the headteacher, V.I. Specialist teachers and classroom teachers about the effective methods of teaching V.I. pupils Mathematics. The responses were as follows:

1. The headteacher should seek advice from the Support Service and ensure that appropriate concrete materials were available for the children.
2. Staff should have an awareness of some of the problems these children encounter through good in-service training and trying out materials in simulation exercises.
3. Using good concrete materials and lots of discussion and talking through the activities.
4. Making sure children understand the reason behind the activity e.g. measuring. This is often overlooked and a child with visual impairment may find the activity of 'measuring' pointless and frustrating.
5. "Share the Purpose" with the pupils.

The headteachers and Adviser-SEN were concerned with organisational matters which included enlarging print size for the child, making sure specialised equipment was available and used appropriately. They had also stressed the importance of working co-operatively to share an awareness of some of the problems that V.I. children were encountering. This could best be done by good inservice training which would include using concrete materials e.g. beads, seeds, shapes etc. and simulation exercises. Most importantly, "sharing the purpose" of the exercise with V.I. pupils.
Some of the examples, such as:

1. Need for flexibility in process of teaching in order to meet individual children's needs.
2. Adaptation of the materials in order to give other children like V.I. children a full access to the curriculum
3. Discovering the child's level of attainment.
4. Increase teacher/pupil contact.
5. "Sharing the purpose" of an activity with V.I. pupils etc.

are also mentioned in the literature review as a means to the differentiation of the curriculum. This is because several authors like Weston (1992), Ainslow (1990) and Lewis (1992) regard differentiation of the curriculum as an important issue if teachers are seeking better ways and means of meeting all children's needs regardless of different abilities, disabilities and backgrounds. The advantages and disadvantages of this process are also discussed in Section Two.

4.5 IDENTIFICATION OF SUPPORT IN TERMS OF RESOURCES NECESSARY FOR TEACHERS AND PUPILS

Several questions were asked based on what kind of support and resources visually impaired children and their teachers receive.

Question (5) (Appendix 1) asked for opinions on effectiveness of specialised equipment. The classroom teachers' responses were that some of the specialised equipment is good in the sense that it aids the V.I. child in his learning. They said some of the specialised equipment was more essential than others e.g. Perkins brailler.
They discounted spectacles and closed circuit television because they said spectacles are not adjustable and that the C.C.T.V. seems very slow. What they do not realise is that practice would speed up the use of C.C.T.V. and that perhaps more light would help with the use of spectacles. The children need to do things for themselves and time must be made available for pupils to complete tasks.

The V.I. Specialist teachers' responded that expensive equipment would be bought only after careful assessment and discussion. The children must be trained to use such equipment. Expensive equipment is not always the solution to a problem. At times simply enlarging print or seating a child near to the blackboard will be enough to help him. Sometimes parents choose to purchase special equipment - hopefully with advice to help them make a suitable choice.

Question (6) (Appendix 2) was asked also to the V.I. Specialist to give examples of situations when specialised equipment would be used with individual children, a pair of children, a group of children and a whole class. Their responses were that specialised equipment could be used with individual children during measuring and sorting. They said equipment that had been marked with liquid indicator could be used. On sorting they felt that actual objects should be used rather than sorting plastic counters, animals etc.

They felt that a V.I. child could be paired with his sighted peer when doing a practical job e.g. in weighing when using scales. They also said specialised equipment could be used for a group of children when introducing a new topic e.g. angles to show different turns and that marked angle protractors could be used. For the whole class they felt that if there was any specialised
equipment to be used it could be during the class demonstrations e.g. Time - the teacher would need to use a large display clock but they did not state what should be done in relation to the V.I. pupils who may not be able to see the demonstrations very well or not at all.

Question (6) (Appendix 1) was asked to the classroom teachers and V.I. specialist teachers to state what other learning materials are given to V.I. pupils with the view to help them understand and find Mathematics useful. Both the classroom teachers' responses did not address the question. This was seen from the answers which they gave which were:

1. Enlargement of work.
2. One to one support by V.I. Specialist teacher.
4. Preparation of braille materials.
5. Auxilliary support for V.I. child for Mathematics only.

From the specialist teachers' point of view the responses were:

1. Materials are to be purchased.
2. Most learning support materials are made in the school e.g. table bingo.
3. Maths scheme is well equipped in the school, not anything special for V.I. children is needed, except what is provided but being adapted.

The fact that the researcher did not get the correct answers to this question was perhaps due to the fact that the question was not clear enough. Perhaps the researcher could have asked them to list in order
of priority five pieces of learning support materials which they found useful for teaching and learning Mathematics. The same thing with the headteacher was observed.

Question (7) asked them to state how the materials were financed. The classroom teachers said they did not know anything about finance issues and therefore they referred this question to the V.I. Specialist teachers. The V.I. Specialist teachers' responses were that they receive a budget from Regional Office and from that budget they purchase some of the learning materials the V.I. children and teachers needed.

The headteacher was asked the same question. The response was that if the staff on the unit wanted to purchase some new materials and equipment she met with them and had a discussion before purchasing those materials and equipment.

Question (8) (Appendix 2) asked the V.I. Specialist teachers to mention a way or ways in which the classroom teacher, School Based Resource Centre, Regional Resource Centre and Scottish Sensory Centre are involved in material production or support for these pupils. Their responses were that classroom teachers are responsible for the day to day management of the V.I. pupils' Maths, materials and curriculum. They said classroom teachers consult V.I. Specialist teachers to give advice on layout of materials, adaptations to the text etc. They said the classroom may give advice to the V.I. Specialist teacher as to what she needed.

They mentioned that from the School Based Resource Centre tactile diagrams, enlargement of print size and
transcribing of print into braille and vice versa were alone in there. The Regional Resource Centre said it could be used for borrowing on short loan periods certain materials and equipment and that the textbooks, worksheets etc may be adapted and enlarged there. Scottish Sensory Centre said they could advise on materials to be bought.

Question (9) (Appendix 1) asked the respondents to state what they thought the role of the parents was in their V.I. children's education. Various responses were drawn from this question but the researcher felt that the question was a bit too remote to the research topic and therefore responses were not to be analysed. See (Appendix 8) for the classroom teachers and V.I. Specialist teachers' responses.

Question (10) (Appendix 1) asked the classroom and V.I. Specialist teachers about how effective is the relationship between themselves. Their responses are summarised on table 4.5.1 below:

Table 4.5.1 summarises the responses of classroom and V.I. Specialist teachers on their working effectiveness.

<table>
<thead>
<tr>
<th>CLASSROOM TEACHERS Responses</th>
<th>V.I. Specialist Teachers' Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Collaborative working.</td>
<td>1. V.I. Specialist teacher should be flexible to find out how the classroom teacher operates.</td>
</tr>
<tr>
<td>2. Materials are got from V.I. Specialist teacher at the right time</td>
<td>2. Give classroom teacher support help the classroom teacher to her own skills and techniques.</td>
</tr>
<tr>
<td>3. Strong back up/support from the V.I. Specialist teachers</td>
<td>3. V.I. Specialist teacher need to explain what they are doing to classroom teachers.</td>
</tr>
<tr>
<td>4. They rely more on the V.I. Specialist teachers initially</td>
<td>4. Develop team approach.</td>
</tr>
<tr>
<td>5. Working as a team.</td>
<td>5. Both V.I. Specialist and classroom teacher need to have a very strong relationship in order that they work out how the child should be supported in classroom or on withdrawal basis.</td>
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<td></td>
<td>6. The V.I. Specialist relieves classroom teacher some of the pressures.</td>
</tr>
<tr>
<td></td>
<td>7. Both classroom and V.I. Specialist teachers should work out proper timetable which will suit them.</td>
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</tbody>
</table>
and V.I. Specialist to state what they considered to be the major roles that V.I. teachers play in supporting both the classroom teachers and the V.I. pupils in the classroom. The main roles are to access the curriculum to the V.I. pupil; to interpret the implications of the child's visual impairment to the class teacher, to help in preparation of appropriate materials to liaise and work co-operatively. In both the Unit based support and Peripatetic support the aim will be the same. The Specialist Teacher's role will be a consultative one, supporting pupils, teachers and at times, parents.

Question (11) (Appendix 2) again asked the V.I. Specialist teacher to state the type of functions they perform in the classroom, resource centre/units, in the whole school and outside the school. Their responses were that in the classroom they give support to both the classroom teachers and the V.I. pupils. They observe the pupils performing tasks in the classroom, they may work with the V.I. pupils individually or work with a group of children including those who have less sight or no sight and they said they may train the partially sighted how to use their residual vision profitably. They also said they provide professional expertise by trying to detect the child's difficulties in his learning.

The V.I. Specialist teachers said in the resource centre unit that their duties were to provide additional materials for V.I. pupils' needs to link with other professionals e.g. psychologists. V.I. Pupils, etc and that they give specialist input e.g. technology. In the whole school they said they ensure that liaison between teachers is carried out regarding the needs of the V.I. pupils.

From outside the school they said they link with external agencies e.g. Examination Board. They also mentioned that they are responsible for home and school liaison.
Both the classroom teachers and V.I. Specialist seem to emphasise a network of support working together for the benefit of V.I. pupils who are integrated in the mainstream schools. This term "Support" seems to refer to many different disciplines. This was observed from the literature review Moore (1992) "Good planning for curriculum support at whole school and key stage/department level will greatly enhance the possibility of efficient curriculum support in the classroom".

Question (10) (Appendix 2) asked the V.I. Specialist teachers to state specific situations in which they think they are directly involved with the classroom teachers working as a team. Their responses were:

1. Forward planning.
2. Discuss content of work.
3. On assessment.
4. Time tabling.
5. Work together at the time of introducing a new topic or concept.
6. When positioning the V.I. child in the class.
7. When the V.I. child is in danger.

The V.I. Specialist teachers' response to question (11) appeared to have agreed the same with the above question (10).

They considered good co-operation of working together and consulting each other whenever necessary very important. It seems that a strong back up of these childrens' learning is through a strong support system from both classroom teachers and the V.I. Specialist teachers.

Question (11) (Appendix 1) asked the classroom teachers
Question (14) (Appendix 1) asked the respondents to state how was their on-going staff developments needs met. The classroom teachers responses were that there were courses for staff development which were divisionally initiated. They said the School based one was done informally and incidentally whenever a need arose.

The V.I. Specialist teachers felt staff development should be done all the time. They stated that priority areas should be established and build from there to see how best the classroom teachers could be helped so that in turn they could help the V.I. pupils in their classes. The V.I. Specialist teacher felt that time should be allocated to school in-service workshops.

Question (14) (Appendix 2) requested the V.I. Specialist teachers to state four areas where staff development played a major role in helping to deal effectively with V.I. children who have problems in Mathematics. Their responses were:

1. Teachers needed to be given awareness on the problems that V.I. pupils encounter in learning Mathematics.
2. The V.I. Specialist teachers need to discuss the importance of forward planning and consultation between them and the classroom teachers.
3. There should be some specialised courses on visual impairment (discussing the implication of some of the visual impairments).

Question (8) (Appendix 3) asked the headteacher to state five topics which he would find quite useful when staff developing teachers with visually impaired integrated in their classroom. The response was that in their school they had not spent or devoted more time to staff developing teachers with V.I. pupils in their classes because there was only one V.I. pupil in the school. However, he said they once had an input on staff development whereby they were trying simulation spectacles
and working with materials to have an awareness on the problems that these children face.

Question (1) (Appendix 4) asked the Adviser SEN to state what role she played at national, regional and institution level in order to facilitate education for the V.I. children in her region. Her response was that she had a responsibility as head of Service for Pupils with visual impairment. According to her there was a Senior Teacher (Peripatetic) who worked with individual pupils in schools across the region and with young pre-school children.

Question 2 asked the Adviser SEN to state what she considered her role at school level in relation to the headteachers, Specialist for visually impaired children and the classroom teachers. Her response was that she worked through the Senior Teacher mentioned above. She said she would only become involved with individual children in very special circumstances.

All the respondents had placed a high priority to the support and adequate resources in order that the V.I. pupils' needs can be met. Although the V.I. Specialist advise that adaptations and modifications should be made to the materials and equipment the sighted pupils use rather than purchasing expensive equipment which will only be used by one child.

4.6 METHODS OF ASSESSMENT

Question (12) (Appendix 1 and 2) asked the respondents to mention how V.I. children are being assessed in relation to Mathematical skills and visual functioning. The classroom teachers' responses were:
1. Use observation and personal judgement.
2. Continuous assessment by looking at the child's work and keeping reports which are sent to the parents.

The V.I. Specialist teachers' responses were that if the child was to sit a test or an examination his problems should be known beforehand. They also said consideration on preparation of arrangements of the examination papers should be taken into account. They also said that ideally pupils should be assessed using the methods by which they were taught e.g. large print size - then it should be ensured that they are supplied with it. They also said the classroom teacher should assess the child by observing and determining the effort and the ability of the child. In the case of the V.I. child who may not be able to use either braille or print then another strategy should be adopted.

Internal and external testing - normally a V.I. Specialist teacher is given a copy of the examination paper to see if adaptations and modifications are necessary. The time factor was another issue here. The child may be allowed extra time and be allowed to use low vision aid if required. They also pointed out that there are situations where a child will need a tape recorder and therefore a separate room may be arranged for him. They also mentioned that normally, if a school has a child with special needs, who will be taking examinations, it is their duty of that particular school to negotiate for special examination arrangements. The V.I. Specialist teacher at this point advises on the pupils' requirements e.g. the type of visual impairment the child has and its implications.

The V.I. Specialist teachers' responses on how they assess the children's visual functioning were:
1. Observes the V.I. child and works out how he uses his residual vision.
2. Check or see whether the child uses his vision in the best possible way.
3. Identify how best can this child get assistance to utilise his residual vision.
4. Check or test the child's visual functions e.g. distance and near vision with use of specialised tool, such as Maclure-Reading Type.
5. Child's vision may be tested in his own classroom or be withdrawn. Testing the child's visual functions in the classroom might even help the classroom teacher to establish for herself what he can and cannot see.

4.7 PARTICIPANT OBSERVATION

The researcher's main reasons for conducting this method were:

1. To find out how visual impairment causes problems to the child's ability to learn Mathematics.
2. To assess how the child uses the adapted curriculum materials (if available).
3. Observe if the child has any visual behaviour which stops him from performing adequately in Mathematics.
4. To see how the teacher's methods match the visually impaired child's style of learning.
5. To observe if the child has learnt any of the new concepts and skills that were taught.
6. To assess if the child was allowed extra time to complete his tasks.

The two V.I. pupils shadowed were treated differently and therefore two observations schedules were made for them.
The observer was interested to see how the teacher varied her methods of teaching in order to meet the needs of these children.

4.7.1 OBSERVATION SCHEDULE FOR CHILD A:

The features that were observed on this child were:

1. Whether the child was on the particular task because the teacher directed him or he initiated it himself.
2. Were teacher's methods and approaches of teaching suitable for the child?
3. Whether adapted materials and equipment were available for this child to use and that he understood correctly.
4. Whether the child's unusual visual behaviour and the characteristics of behavioural problem that were cited have any impact on this child's learning.
5. Whether the child was able to apply what he was taught.
6. Was the child allowed adequate time to complete his task successfully.

Observation Schedule was made. It outlines the elements that the researcher had intended to observe when shadowing this child A.

This child was partially sighted. He had an eye condition of retinopathy of prematurity, nystagmus and strabismus see (Appendix II). The three conditions linked together are likely to pose some serious difficulties to his learning e.g. nystagmus causes involuntary movement which may interfere with visual acuity.

Having realised that the child showed some kind of visual behaviour an observation for ten minutes through time
time sampling was conducted. He also showed characteristics of behavioural problems which was also time sampled. The elements that this child showed on visual behaviour were the tendency to poke his eyes and tilting of his head from time to time. The behavioural problem characteristics shown by the child were wandering around and moving from one table to another. His movements suggested to the observer that other pupils were being distracted from their work because he was asking for pencils and rubbers from them at inappropriate times and disrupting them. See (Appendix 6) for recordings.

The graph 4.7.1 below shows the results gained from the time sampling of the child's visual behaviour and the behavioural problems showed at the time of observation.

Visual behaviour and behavioural problems

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Key: EP - Eye Poking, HT - Head tilting, WA - wandering around, DAP - Disturbing another pupil.

Basically, from the graph it shows that the child's visual behaviour and the behavioural problems equally
impinge on the child's learning because in six out of ten minutes the child was involved in a great deal of movement rather than completing his task. It also shows on the graph that this child tends to poke his eyes and tilt his head when he was on task. This could mean that the child was trying to use his residual vision to his ability. Another reason for moving up and down could be that the child has a poor concentration span. Also this problem of low level concentration was observed by his V.I. Specialist teachers when they were doing a review on his needs. See (Appendix 10).

In observing how the teacher's methods of teaching were applied to meet the needs of this V.I. child, a Maths lesson on shapes, matching, making and drawing was observed. The teacher demonstrated to the pupils how they should build a square, triangle and pentagon with straws. More explanations were made to one group which this child belonged to. Thereafter, the pupils were asked to build the shapes as mentioned above with straws and to draw them.

This child was not able to form the shapes with the straws or draw any shape until he got assisted by the class auxiliary who helped him to build it but still the child experienced some problems in drawing the "square" which he was helped to form. Before the child could finish his task they had to go for lunch break. Whether the child was going to be allowed extra time to complete his work the researcher did not know.

Having observed that this child was not able to perform
the set task the researcher with the assistance of V.I. Specialist teacher decided to make a follow up observation on the same activity with the child and his other visually impaired classmate took part as well. The activity took place in the unit during lunch break time.

The first thing the pupils were asked to do was to have their pieces of papers, ruler and pencils ready. The pupils were asked to draw first a triangle, square and pentagon. For the purpose of this activity Child A was called J or J.D. Therefore, J. managed to draw a triangle and square and encountered problems with a pentagon. See (Appendix 9). His counterpart managed to draw a triangle and pentagon properly and had problems with a square. See (Appendix 5) for the observer’s recordings.

In the second incidence the pupils were asked to get straws and make first a triangle, square and pentagon. They were helped and allowed to count the straws used. Child A or (J) managed alright with the same shapes as above. He got the pentagon wrong again. Again see (Appendix 5) for recordings. The other child got a triangle wrong this time.

The third step, the researcher got a tray of 2 dimensional plastic shapes and asked the pupils to select squares, triangles and pentagons of different sizes and put them together. Child A managed well with the same shapes. This child when realising that he got the pentagon wrong again he asked and said "where is the pentagon?" At the end of this
follow up activity the observer realised that this child A or (J) seemed not to have had an idea of what a pentagon looked like. He knew what a triangle and square looked like. There was no doubt that this child had formed a good concept of shapes. Therefore it implied that something was wrong with the teacher's methods and strategies of teaching. This may include not being able to give enough help to the child individually which could have been done by the teacher herself or class auxiliary especially at the time of introducing the activity or topic. Another thing which was observed was that the child seemed not to have understood the teacher's instructions because the child did not draw a single shape by himself. The other thing was probably the child was not allowed to handle and explore the materials that he was going to use.

The observer thought that it could have been helpful enough if V.I. pupil was permitted to be next to the teacher and be allowed to handle the straws during and after the display he would have been more involved and have more understanding of what was happening. Probably individual help was also required. Perhaps the teacher could have used straws of different colour for this child if possible. Contrasting materials would help.

There was adapted materials but no other specialised equipment e.g. tactile ruler for the child to use for drawing. Spectacles had not been prescribed for this child.

This child seemed to be unable to work on his own unless he had assistance. This was identified during
the activity prescribed above when he could not even make a single shape with straws.

Therefore this child needs a lot of support and more structured work to be able to work. This has been cited by his V.I. Specialist teacher. Also see (Appendix 10).

4.7.2 OBSERVATION SCHEDULE FOR CHILD B

This child is totally blind. She lost her sight because of a certain unique syndrome which was not known. This syndrome had affected other parts of her body especially the left hand. She is not able to hold things properly. It shakes all the time. The child uses her right hand to locate, read and scan and write braille.

It appeared that the child was receiving some form of therapy on her left hand.

For this child B certain features which were to be observed were identified also. They were more or less similar to those of child A except the fact that child B has physical disability. She follows her own individual programme at her own pace. She was a braille user. She was receiving support from both the V.I. Specialist teacher and class auxiliary. They plan, prepare and adapt her materials. For instance she had a recorded programme in the tape recorder.

This child was also observed during a Maths lesson offered by V.I. Specialist teacher in the unit with the view to observe how effective the teacher's methods were in relation to this child. The activity was
adding using a bingo table. There were seven problems on addition for this child to solve e.g. 50 + 14. The child was able to give correct answers to all seven sums. She was competent with her bingo table. She was able to give her answers as fast as the sighted average child could. It was seen even during the activity that the child had good concentration from the way she was participating in the exercise mentioned above.

The V.I. Specialist teacher taught the blind child braille, etc. in a one to one situation. However, prepared work was in place in the classroom daily so that the pupil was able to spend time in her class working alongside the other pupils. The V.I. Specialist teacher prepared and taught much of this pupil structured individual programme in the Visual Impairment Unit. As a result the child just joins other pupils for social reasons. The sitting arrangement for this child at times was that she faced towards the wall and had her back towards the rest of the pupils. This allowed access to power points. Her special equipment required extra space. She needs a desk/table to herself. At other times this child was part of a small class group.

The child was more activity directed. She does a lot of her work on her own all the time without being directed by her teacher. This was observed when she was putting away her Maths paper and starting work on an English exercise. For the specialised equipment provided for this child see (Appendix 7).

4.8 ANALYSIS OF DATA COLLECTED WITH INTERVIEWS AND OBSERVATIONS:

Questions 1 and 2 of research focused on the problems that V.I. pupils encountered in learning Mathematics.
and their possible causes.

The classroom teachers seemed to be giving more general ideas that practical work is a major difficulty. The V.I. teachers were citing the problems of degree of visual impairment being the cause of some of the problems that these children experience in learning Mathematics. They were more specific in that V.I. pupils lack experience in incidental learning, have poor hand and eye coordination, and need appropriate teaching and learning strategies. They have also cited inadequate verbal instructions to be another cause of these difficulties of learning Mathematics. Fundamental issues such as checking that the V.I. child has understood instructions is vital, as the child cannot use visual cues to help himself. The researcher had cited this point since she observed that during a Mathematics activity a child was asked to build shapes with straws and draw them but he could not perform this task.

This implied that the class teacher assumed that the child understood the instructions. It is important that V.I. children are to be given clear and adequate instructions on an individual basis if possible.

The delay in language and cognitive development have also been seen as a great cause of the difficulties for learning Maths. Some of these causes have been cited by other authors in the literature reviewed. For instance, Clamp (1992) has noted that lack of natural visual experiences in basic number awareness can limit the child's opportunities for understanding basic concepts.
Questions 3 and 4 of the research questions were mainly geared to the effective methods of teaching and learning strategies of the V.I. pupils. The classroom teachers were concerned about the time that they spend with the pupils trying to give them assistance in their work. The teachers were aware that it took much longer for their V.I. pupils to complete some tasks. This, in turn, tired them. The V.I. pupils, especially infants, may need shorter tasks to allow them to complete in a shorter time. Finding time for short breaks in between tasks can be important.

The V.I. Specialist teachers are much more specific on starting with assessment which will determine flexible methods of teaching and learning strategies to meet the individual children's needs. Evidence is seen whereby child B is made to follow her own individual programme at her own pace but being part of the whole class. There is no doubt that this child's needs are being met through the method of differentiation of the curriculum. There is flexibility in the teacher's methods to meet the needs of that child in learning Maths.

Questions 5 and 6 of the research questions were directed to identify the kind of support/resources these children and their teachers receive. The V.I. Specialist teachers were of the opinion that children with visual impairment should use the same materials as sighted children but it might need to be adapted or modified rather than buying expensive equipment for one child.
The researcher seemed to agree with the idea of adapting and modifying the materials which the sighted children use rather than buying an expensive piece of equipment which may be used by one child e.g. buying a photocopyer with enlargement facilities and a computer attached to a printer and embossor to produce both print and braille would be useful equipment to all children.

Further to these questions, a question about learning materials was not asked properly as mentioned previously. All respondents valued the support which is offered by the professionals e.g. V.I. Specialist teacher working with classroom teacher to support the V.I. child in his learning. On the other hand the Adviser SEN didn't see her role as being to support V.I. children. Instead she saw her role as supporting the staff through the planning and implementation of staff development opportunities. These can take the form of courses which may be regionally or locally based. They may be formal or informal.

In addition question (7) of research was based on what role could the preschool provision play in relation to preparing V.I. pupils for learning Mathematics. More emphasis could be placed on the value of preschool education as this is considered to be laying foundations to all children's learning including those who are visually handicapped. It seems that it was considered a priority by many professionals.

The writer feels that if V.I. pupils in pre-school are given wide, practical experience in recognising shapes and handling real objects they will then be able to start to build on good basic understanding when they move to Primary Schools. Early intervention
will help blind and visually impaired pupils get a better start in school.

4.9 SUMMARY

This section dealt mainly with presentation and analysis of data collected from the two techniques mentioned in Section Three. The analysis of the interviews and participant observations were treated separately and brought together later in the section. Having done the analysis, the writer will summarise the findings of this research in the form of conclusions, implications and recommendations in the next section.
SECTION FIVE

CONCLUSIONS? IMPLICATIONS AND RECOMMENDATIONS

5.1 OVERVIEW:

This section summarises and gives conclusions of data analysed in the last section. The purpose of this section is to come up with the most important aspects covered in this research project; to highlight the implications that are envisaged for the situation in Botswana; to make recommendations to Botswana. The writer hopes that these will benefit those teachers who are facilitating education for children and young people with visual impairment.

5.2 CONCLUSIONS

This will be drawn from the analysis presented in section Four. The following conclusions are made.

1. The class teachers are concerned about time factor in relation to the problems that V.I. pupils are encountering in learning Maths. For instance they consider them being slow in decoding information and that they take too long on practical work whereas the V.I. Specialist teachers are more concerned about the methodology in the sense that they say these children are not able to see clearly or they cannot see entirely and that therefore if materials are not clear and concrete they are likely to face problems in their learning.

2. The major causes of the problems that V.I. pupils
encounter in the learning of Mathematics is still seen in the light of time factor again by the class teachers as they feel these children are unable to comprehend the problem and that they are encountering a lot of strain in their work. The experienced V.I. Specialist teachers consider that the problems are being caused by:

(i) the implications of visual impairment,
(ii) lack of experience and incidental learning
(iii) poor methods of teaching and learning strategies,
(iv) learning difficulties.

3. The respondents considered differentiation of the Maths curriculum through the means of

(i) flexible teaching methods and learning strategies
(ii) adaptations and modifications of learning materials e.g. Maths braille for the blind pupils and enlarged print size for the partially sighted children
(iii) direct support where necessary
(iv) use of concrete materials e.g. counting blocks, 3 dimensional shapes
(v) use contrasting colours e.g. black to yellow background colour
(vi) observing the child to anticipate where the problem is likely to be
(vii) planning ahead, considering the needs of all children, groups and individuals

very important and appropriate in order to meet the needs of individual pupils. By so doing this will give V.I. children a full access to the Maths curriculum also.

This is supported by Warnock (1978) when she reminds us that the goals of education are the same for all
pupils even though they may be achieved in different ways at different times.

4. All the respondents considered support in terms of human and materials resources as being important in giving V.I. pupils full access to Maths curriculum. Specialised equipment is also regarded as a priority. Finance has been considered a major factor as well. This is because without finance, resources will not be available. The V.I. Specialist teachers also value the specialist support highly important in the sense that through their role of consultancy they are able to share ideas with other mainstream colleagues on the effective methods and strategies of teaching V.I. pupils Maths.

5. In-service training and staff development are seen to be a priority in that through them V.I. Specialist teachers and Adviser SEN are able to share ideas and information on the problems of visual impairment and the methods and strategies of teaching V.I. pupils in their mainstream classes. This can be done formally or informally e.g. the V.I. Specialist teacher may staff develop their mainstream colleagues by conducting awareness courses on some of the problems the V.I. pupils encounter in learning Mathematics.

6. All the respondents place a high importance to assessment of the pupils work in order that some kind of feedback is got from the child. The teachers believed in various methods of assessment for instance to observe the pupil to determine his effort and ability or the teacher may look at the children's work all the time and keep records for individual children's work. They also prefer that the pupil should be assessed
based on the methods by which the child was taught e.g. large print size.

Internal/external Testing are criterion reference based. That is pupils are tested on what they have actually done. In the case where a V.I. pupil is to sit an examination the V.I. Specialist should know before hand the child's problems. This is to advise in the preparation and organisation of the examination paper materials.

The V.I. Specialist teachers consider assessment of visual functioning very important. They regard careful observation necessary because it will enable them to identify ways in which different V.I. pupils especially the partially sighted pupils use their residual vision in different activities. This will aid them in how to prepare materials for each child. They recommended that specialised tools such as Look and Think Checklist (Tobin, Chapman et al 1978), Maclure-Reading Type etc could be used for more formal assessment.

7. All the respondents placed utmost importance on pre-school education in that they said for V.I. pupils it exposed them to a lot of activities through which they would be able to develop certain concepts. Parents could be trained or advised in how to keep their child at home.

5.3 IMPLICATIONS TO THE BOTSWANA SITUATION

The conclusions stated above will have some implications to the provision of education for V.I. pupils in Botswana mainstream schools.

In Botswana, V.I. Specialist teachers would like to be
involved in the implementation of the Maths curriculum and to have opportunities to study their V.I. pupils to find out what kind of problems they are experiencing in Maths. The problems the researcher is anticipating is that there will be no one to produce braille materials and that the class teacher may feel threatened to join in team teaching or accepting direct support for the V.I. pupil from the V.I. Specialist teacher. They may feel that the V.I. Specialist teachers are intruding and would feel threatened by the presence of a V.I. Specialist teacher.

The same thing will apply as mentioned above because once the V.I. Specialist teacher starts to be involved in supporting the V.I. children in classes to study their problems, there will be no one to produce braille materials. Another problem is a lack of literature on the problems and causes of visual impairment for the teachers to consult.

In the Curriculum National Guidelines in Mathematics (1991:63-29) for Scotland it is stated that provision for adaptations should be made in order to meet the educational needs of children and young people including the V.I. children. This ties in with what the respondents mentioned about differentiation of the curriculum being the key factor in meeting the educational needs of these children. As they have mentioned above these needs can be met in many different ways e.g. through flexible methods and adaptation of the materials as
it is stated in 5-14 National Guidelines.

Unlike Botswana, the curriculum is rigid as it is exam oriented - see (Section 1) for the problems about the education system in Botswana regarding the V.I. pupils. Because of large classes class teachers are not able to employ flexibility in their methods of teaching. Issues, like the one stated above of large classes, are related to the lack of a national policy on special education. The teachers may feel incompetent to cope with diversity of different individual children's needs because of a lack of adequate training. Without a national policy on special education and without adequate training for teachers it will be difficult to meet the needs of all children, groups and individuals.

The human and material resources support in Botswana is difficult to maintain because of lack of finance. This may mean a lack of specialised equipment for blind and visually impaired pupils. Kesupile A.S. (1992) cited that there were approximately 50 trained special education teachers in Botswana which equals 0.4% of the total of Botswana's Teachers. This is clear evidence that there is less or no training done to meet the growing number of children and young people with special educational need in the country. This serious problem has lead and contributed to the fact that the V.I. Specialist teachers are not being involved in the actual supporting of these children in their classes or taking part in team teaching with their mainstream colleagues. It would not be easy for V.I. Specialist teachers to offer direct support to the V.I. pupils in the classroom because their major role of support
is through transcribing braille for the blind pupils, who seem to be grater in number than the partially sighted children.

The staff development and in-service training touch on the issue of finance as well. The V.I. Specialist teachers would like to hold school base workshops with their mainstream colleague teachers, but their major problem is that of braille production materials. They would not have time to do that as most of their time goes into producing braille materials and tactile diagrams.

The class teachers would appreciate training in visual impairment to enable them to assess the child's level and know what and how to teach him of functioning. Therefore they would be unable to do that because of the problems which are posed by the curriculum. This includes both internal and external testing. The other problem which has been cited by the researcher is that it may not be possible that V.I. Specialist teachers are consulted in the preparation of the examination for their pupils because of confidentiality. On the other hand there is no liaison between departments which cater for the education and the welfare of these children and therefore it might be difficult for the V.I. Specialist teachers to intervene in some cases.

The V.I. Specialist teachers would appreciate assessing V.I. pupils' visual functioning in order to establish how the child uses his residual vision since this may help them to identify the best way the child should be helped. It could not be possible with the V.I.
Specialist teachers in Botswana because to begin not with they are/directly involved with the implementation of the curriculum. The other problem may be of purchasing the assessment tools to carry out the formal assessment of visual functioning.

10. In Botswana, pre-school education for these children can not be possible because of lack of resources. It would be difficult and expensive to run a programme like that in Botswana.

5.4 RECOMMENDATIONS

In general, the writer, feels that she has benefited much from undertaking this project although there were a lot of problems to be tackled.

The writer recommends that in order for the situation in Botswana to be improved all interested professionals including the researcher herself should adopt the following courses of action, namely:

1. A need to conduct some more research in the field of visual impairment.
2. The V.I. Specialist teachers to develop their consultancy role and get into classroom work with pupils and help mainstream teachers.
3. Braille should be produced using a computer, braille transcription programme and embosser as this system will speed up the process of braille production and thus allowing the above mentioned V.I. Specialist teachers into the classroom to support pupils.
4. The V.I. Specialist teacher should ensure they have up to date information on pupils visual functioning and/or they should do visual assessment themselves and perhaps with the class teacher present so that she understands how much her pupil sees.
5. In consultation with class teacher she should identify the problems that V.I. pupils are having in Mathematics then advise the teacher on how she could help the pupil overcome the problems.

6. The V.I. Specialist teachers themselves should meet for consultation and support. They should know where all the resources are so that they are shared and developed again e.g. if text material is already available in braille it could be run off the thermoform a second time.

7. Staff development programmes or in-service training should be undertaken in order that class teachers are helped to improve their methods of teaching to meet the needs of different children with different abilities. They should also be helped to understand the problems these children are experiencing in their learning of Mathematics.

8. The education system (Spec.Educ.Unit) should also make sure it gets clear and proper national policies which will guide the educational provision for all children and young people with special educational needs. There should be liaison between all organisations which are responsible for facilitating education for V.I. pupils e.g. Department of Curriculum Development and Evaluation should consider having an expert in the field of special education to co-ordinate and organise things to meet the needs of these children satisfactorily.

9. Both internal and external testing should take into account methods in which the child was taught and that adaptations and modifications should take
into account what the child has covered.

5.5 SUMMARY

This section attempted to sum up the different issues discussed in this research project. The Conclusions, Implications and Recommendations were formulated in it as well. The writer hopes that the findings that came up in this research and the recommendations made may be of help to her and all those who are in education for the V.I. pupils in Botswana.
APPENDIX 1

INTERVIEW SCHEDULE:

HEADTEACHER, TEACHERS AND V.I. SPECIALIST TEACHERS

CURRICULUM

1. In your experience with visually impaired children, what problems have you identified that visually impaired children normally encounter in mathematics?

2. What in your opinion are the main causes for these problems?

3. What do you do in order to solve these problems?

4. What methods do you use in teaching the visually impaired children?

5. In your opinion, how do you rate the effectiveness of specialised equipment that is used to teach visually impaired children?

6. What other learning support materials are given to the visually impaired children?

7. How are the materials financed?

8. How helpful or effective do you think the Preschool is to a visually impaired child in relation to teaching and learning of number work?

9. What role do parents play in helping visually impaired children in learning number work at school and at home?

10. How effective is the relationship between classroom teacher and the specialist teacher?

11. The V.I. specialist teacher plays an important role in supporting both the child and the teacher in the classroom. What exactly are the major functions of the support teacher?

12. How are visually impaired children assessed in relation to mathematics skills and visual functioning?

13. How do you differentiate the 5-14 Mathematics Guidelines in order to meet individual needs of the children in your classroom?

14. How are on-going training needs for staff development met, e.g. new technology, ideas methods and policies practices?
APPENDIX 2

VISUALLY IMPAIRED CHILDREN

1. Give specific examples of problems that visually impaired children encounter the following areas:

   A. Abstract concepts.
   B. Investigation.
   C. Application.
   D. Problem solving.

2. How do the following contribute to the visually impaired child's failure to grasp correct mathematics concepts:

   A. Degree of visual impairment?
   B. Teaching strategies/ methods and learning styles?
   C. Lack of adequate instructions?
   D. Child's own home background?

3. How can a teacher in an integrated classroom try to solve these problems caused by:

   A. Degree of visual impairment?
   B. Teaching strategies/ methods and learning styles?
   C. Lack of adequate instructions?
   D. Child's own home background?

4. Give example of situations in which a teacher in an integrated classroom would make use of the following in trying to help a visually impaired child overcome problems encountered in mathematics:

   A. Differentiation.
   B. Flexibility.
   C. Adaptations and modifications.
   D. Direct support.

5. When would a teacher make use of the following in enhancing effective learning of mathematics for the visually impaired child in an integrated class:

   A. Individual approach.
   B. Group approach.
   C. Whole class approach.
6. Would you give examples of situations when specialised equipment would be used with:

   A. Individual children.
   B. A pair of children.
   C. A group of children.
   D. Whole class.

7. Which children in an integrated classroom would normally make use of:

   A. Tactile diagrams?
   B. Enlarge Print?
   C. Contrast background?

8. In what way or ways is each of the following involved in material production for the visually impaired children:

   A. Classroom teacher?
   B. School based resource Centre?
   C. Regional Resource Centre?
   D. National Resource Centre?

9. How does the preschool prepare visually impaired children for number work in the following areas:

   A. Number concept formation?
   B. Measuring?
   C. Sorting, matching and classification?
   D. Material handling?

10. In what specific situations does the classroom teacher work hand in hand with the specialist teacher as a team.

   A. ........................................................
   B. ........................................................
   C. ........................................................
   D. ........................................................

11. What function (s) does the specialist teacher for V.I. pupils perform in the following given situations:

   A. Classroom?
   B. Resource centre/unit?
   C. The whole school?
   D. Outside the school?
12. How are the following assessments carried out in relation to visually impaired children:

   A. Continuous assessment?
   B. Internal/external testing?
   C. Functional vision assessment?

13. Give FOUR areas where staff development plays a major role in helping teachers deal effectively with visually impaired children who have problems in mathematics.

   A. ..............................................................
   B. ..............................................................
   C. ..............................................................
   D. ..............................................................
APPENDIX 3
INTERVIEW SCHEDULE: HEAD TEACHER
VISUALLY IMPAIRED CHILDREN

1. Do you have a policy document which relates to visually impaired children, if so, what does it state about visually impaired children in relation to:
   A. Teacher's attitudes to the visually impaired children
   B. Other children's attitudes towards visually impaired children
   C. Approaches to be used for visually impaired children

2. What provisions are made for visually impaired children in relation to
   A. Physical structures
   B. Resource allocations e.g. special budget
   C. Welfare of the visually impaired children in the school

3. What specialised equipment is provided for use by visually impaired children?
   A. As individuals
   B. In groups
   C. With the whole class

4. In what situations do teachers make use of the following approaches with the visually impaired children?
   A. Individual teaching
   B. Group teaching
   C. Whole class teaching

5. Under what circumstances would you find the following working as a team with the specialist teacher for visually impaired children?
   A. Classroom teacher
   B. Learning support teacher
   C. Peripatetic teachers e.g. Expressive Arts specialist

6. When are you as a head be involved with the following specialist?
   A. Educational psychologist for V.I. children
   B. Local Educational Adviser for Special Education
   C. Social worker
7. What issues do you normally interview parents with V.I. children for, or parents seek interview with you. Give four of such common issues?

A. 
B. 
C. 
D. 

8. Give five topics which you find quite useful when staff developing teachers with visually impaired integrated children in their classrooms?

A. 
B. 
C. 
D. 
E. 

9. What approach would you take in relation to:

A. Allocating a V.I. child to a class
B. Allocating a teacher to class with V.I. children integrated

10. What role does the following lecture play in relation to you as a head teacher of a school with V.I. children integrated in it:

A. Specialised teacher
B. Learning support teacher
C. Classroom teacher
D. Auxiliary teacher
APPENDIX 4

INTERVIEW SCHEDULE:

Local Education Adviser for Special Education Needs (Fife Region)

1. What role do you play at each of the following levels in facilitating the education of visually impaired children?
   
   A. National (Scottish Sensory Centre)
   B. Regional
   C. Institutional / School.

2. At school level, what is your role with each of the following persons?
   
   A. Headteacher
   B. Specialist visually impaired teacher
   C. The classroom teacher.

3. What functions do you expect the headteacher to perform in order to facilitate effective learning of the visually impaired children in relation to:
   
   A. Mathematics as a whole
   B. Helping teachers to overcome problems encountered by visually impaired children in mathematics?

4. What advice would you give to a specialist teacher who has a visually impaired child who has problems with/in:
   
   A. Abstract concept formation
   B. Measuring
   C. Problem solving?

5. What advice would you give to a classroom teacher who has problems in identifying why visually impaired children have problems with:
   
   A. Investigation
   B. Application
   C. Weighing?
Follow up observation for child A

   - J □ R - difficulty
   - J	×
   - R. V

Got straws - make a '△'
- J □ R x
- J V R v
- J X R v

Helped + counted straws used

Got a tray of 24. plastic shapes.
- I selected correctly □ square, 7 different ways
- △ different shapes 12 a different triangle
  a not asked 'Where the pentagon'.

Rae needed help with △ different shapes 12.
APPENDIX 6

OBSERVATION SCHEDULE 2

Child A: Partially sighted

Age: 6  Sex: M
Eye condition: Retinopathy of prematurity, Mystagmus and Strabisms
Subject: Mathematics
Methods of teaching: (Preference in the teacher's methods)

Whole class approach  ☑
Group work approach  ☐
Individual programme/attention  ☐

Support By:
Auxiliary teacher  ☑
V.I. Specialist teacher  ☐

ADAPTED MATERIALS AND SPECIALISED EQUIPMENT PROVIDED
Enlarge print materials:  ☑
Contrast background  ☐
Concrete materials: e.g. straws, rulers etc.  ☑
Tactile materials  ☐
Use of low vision aids  ☐
Others:  ☐

VISUAL BEHAVIOUR:
Eye Poking (EP)
Head Tilting (HT)
Other problems: Moving around (MA) Disturbing Other Pupils (DOP)

Date: 10/02/93  Year group: P2
Main activities: Shapes: matching, making triangles, squares and pentagons with straws and drawing them.

THE CHILD ON TASK:
Teacher Directed (TD) ✓
Pupil Directed (PD)

APPLICATION: very good  very poor

1  2  3  4  5

1. Concentration
2. Participation
3. Were the instructions clear to the child?
4. Completion of the task

Time taken 9.10 - 9.20 am

<table>
<thead>
<tr>
<th></th>
<th>On task</th>
<th>Off task</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP</td>
<td>✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>HT</td>
<td>✓ ✓ ✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>MA</td>
<td>✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>DOP</td>
<td>✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>TOT.</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

COMMENTS:
Extra time was not give to complete the task
<table>
<thead>
<tr>
<th>Child A: Totally blind</th>
<th>Date: 09/02/93</th>
<th>Year group: P4</th>
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</thead>
<tbody>
<tr>
<td>Age: 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex: F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cause of blindness: A certain unique syndrome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject: Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methods of teaching: (Preference in the teacher's methods)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class approach</td>
<td></td>
<td></td>
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<tr>
<td>Group work approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual programme/attention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support By:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auxiliary teacher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V.I. Specialist teacher</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**APPLICATION:**

<table>
<thead>
<tr>
<th>very good</th>
<th>very poor</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
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<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td></td>
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</table>

1. Concentration
2. Participation
3. How did the child understand the instructions
4. Completion of the task

**PHYSICAL DISABILITY**

<table>
<thead>
<tr>
<th>Leg</th>
<th>Hand</th>
<th>Any other part</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS**

Left hand is not working properly
This child follows her own individual programme
TABLE 4.4.3. Summary of the responses of the class teachers and V.I. Specialist teachers on the role that parents play in their children's education

<table>
<thead>
<tr>
<th>Class teachers' responses</th>
<th>V.I. specialist teachers' responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Should be supportive through V.I. children's parents night and meetings with other parents</td>
<td>1. Parents to be supportive</td>
</tr>
<tr>
<td>2. Strong liaison between parents and school helping in children's learning</td>
<td>2. Listen to them in relation to their children's needs</td>
</tr>
<tr>
<td>3. Private meetings with parents</td>
<td>3. Extra help is given to children at home is appreciated</td>
</tr>
<tr>
<td></td>
<td>4. Parents guide and support children at home</td>
</tr>
<tr>
<td></td>
<td>5. Parents involvement is very vital</td>
</tr>
</tbody>
</table>
V.I. REVIEWS- 1.2.93

J. - P2 Room 5

John is more settled in the class - he will always be a mischief.

X He needs as much individual attention as possible. He is still immature.

Background input from Mrs. Foulds. No vision in left eye - some vision in right. His distance vision is very poor (6/60 vision). Blackboard work is virtually out for him.

Material for J. must be clear - Banda sheets sometimes too poor.

J. is very good orally. He is also a good reader.

Playground behaviour is very poor. He is boisterous in running around bumping into people. He does not know how to play outside. J's home life is obsessed by Computer Games. He does not seem to develop outside play. He has two little sisters.

J's painting is now better. His cutting-out skills less good.

J. spends sometime in V.I.C. at lunchtime and plays games etc., some of the time. Supervised by Mrs. X.

X Input support essential on one to one basis.

Contact parents re report sheet and other opportunities to have social interaction.
Maths: He struggles a little in understanding in performing tasks at his class level.

Reading: Reads clearly, with understanding (questions about story).

Writing: Formation of some letters requires reminding.

Generally, in class situations, he appears to cope quite well. He has an engaging manner and is liked by his class mates.

21/5/73

J.

Retinopathy of Prematurity. Retinal detachment complete.


Attends Dr. Dudgeon and Dr. Day at the R.H.S.C. Yorkhill periodically.

Hearing - normal.

Gait - rather wide based and he has poor balance.
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