MEDIA INTEGRATION IN THE TEACHING OF MATHEMATICS IN THE PRE-PRIMARY AND PRIMARY SCHOOLS

by

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PROMOTER: PROFESSOR M.W. DE WITT

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DEDICATION

This thesis is dedicated to my sons and daughter

Popota

Paledi

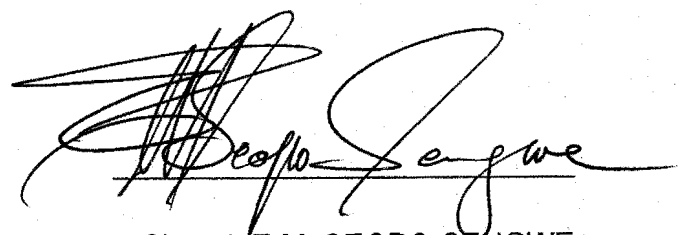
Asirane

Pitso and

Mmenyane

DECLARATION

I declare that **MEDIA INTEGRATION IN THE TEACHING OF MATHEMATICS IN THE PRE-PRIMARY AND PRIMARY SCHOOLS** is my own work and that all sources that I have used or quoted have been indicated and acknowledged by means of complete references.



Signed: E.M. SEOPO-SENGWE

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Topic : MEDIA INTEGRATION IN THE TEACHING OF MATHEMATICS IN THE PRE-PRIMARY AND PRIMARY SCHOOL

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SYNOPSIS

The fundamental purpose of this research is to establish whether mathematics can be taught effectively with the use of appropriate media and to further establish the possible effects of media in the teaching of mathematics.

The research touched on the principles and guidelines of media selection and the various methods that could be utilized in conjunction with media in the teaching of mathematics in the pre-primary and primary schools.

In media selection, the emphasis was that media must be chosen objectively rather than on the basis of personal preference and that the effectiveness of media is dependent on the suitability of the physical conditions surrounding it.

The overall findings regarding media utilization is that most educators believe that media used in conjunction with a suitable or appropriate method should help to actualize what is expected from the learner.

The research method in this study can be divided into a literature study and an empirical investigation. The literature study was done with a view to support the introductory orientation of this study.

The focus was on learning as an active process, it also highlighted how the young learners acquire knowledge and how their interaction with their environment impacts on their cognitive development. The research also dealt with concept formation with special reference to the variety of concepts such as physical sensory concepts, action-function concepts, evaluative concepts and abstract concepts.

The questionnaire was used to gather data from seventy (70) educators about media integration in the teaching of mathematics in the pre-primary and primary schools. An observation guide was also used during the observation of the presentation of twelve (12) lessons by eight (8) teachers from the pre-primary and primary schools. The lessons included the nature and characteristics of media employed in the lessons.

The following factors were taken into account:

(a) lesson plan layout
(b) specific outcomes
(c) contact accuracy and relevance
(d) learner variables and interest
(e) the learning environment and
(f) the mediation capabilities of the educator
(g) availability of media in schools

The discussion of data collected was followed by the data analysis and interpretation. The statistical techniques were used to put the researcher in a position to either reject or accept the null hypothesis. The techniques used were the Wilcoxon Signed Ranks Test, the Pearson Correlation coefficient, the NPar Test and Friedman Test.

On the basis of the findings the researcher has sufficient, concrete evidence to conclude that the results invalidate the null hypothesis tested. Therefore the researcher's conclusion is that:

(a) there is a possible effect of media in the teaching of mathematics lessons in the pre-primary and primary schools.

(b) there is a possible effect of media selection and integration of media in mathematics lessons.

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ACRONYMS

ITV	-	Interactive television
SSI	-	Schedule standardized interview
CD	-	Compact disc
LPAD	-	Learning Potential Assessment Device
USA	-	United States of America
IE	-	Instrument Enrichment
NCTM	-	National Council of Teachers of Mathematics
CAI	-	Computer Assisted Instruction
CMI	-	Computer-Managed Instruction
USI	-	Unscheduled Standardized Interview
UI	-	Instructional Interview
ELC	-	Early Learning Centre
OBE	-	Outcomes Based Education

CHAPTER ONE

INTRODUCTORY ORIENTATION

1.1 INTRODUCTION

Most educators, believe that teaching and learning is not only collecting information or supplying learners with information, but also to employ instructional approaches that would engage the learners interest, sustain it and encourage them to be active participants in the learning situation. In order to capture the learners interest, foster cognitive development and problem solving skills, a resourceful and creative educator would employ instructional media as one of the methods in his/her teaching.

It should however be noted that using a variety of media as such, does not necessarily assure that teaching and learning should or must be effective. Effectiveness depends on the correct use of those media most conductive for the attainment of specific objectives of a lesson.

There is an expressed concern by most educationists about the level of educators' use of instructional media in their lessons (Anandam & Kelly 1981:23; McMeen 1986:46), in a study involving an assessment of the production and utilisation of instructional media by student educators, Carter and Schmidt (1985:30) observed that, although the student educators had received concentrated instruction in educational media during their training, their performance in media utilisation, raised serious questions about the effectiveness of instruction they received. Most of the student-educators relied more on traditional forms of media such as posters and bulletin boards.

Carter et al (1985:31) observed that student educators did not want to commit themselves to instructional materials which are complicated to produce and utilize. Klasek (Lizamore 1974:143) argues that most educators fail to use instructional media because of not being aware of the resources and variety of media available to them. This implies that training in media selection and utilisation must form an integral component of teacher education (Marais 1992:178; Carter et al 1985:32).

The factors that must be considered in the selection of media are:

a) Correctly stated objectives of the lesson and the learners learning goals, that is, the new capabilities that the learner should possess at the completion of the lesson (Heinich, Molenda & Russel 1990:37).

b) The characteristics of the learners, the size and composition of the group to be taught.

c) The learners performance (Lizamore 1978:143; Stowe 1974:74).

Integrating media with teaching and instructional programmes have been found to produce desired learning results (Heinich, et al 1990:11).

According to Sibalwa (1983:30) most students would rather prefer instructional programmes that are accompanied by a variety of media, because they help to improve understanding of the concepts that are being taught.

De Corte (Kozma 1994:16) supports the claim that the integration of media and method with the educational content play a prominent role in achieving desired learning results.

Kozma (1994:9) asserts that media has a positive effect in learning. He cites studies conducted by White (1993:68). "Thinker Tools" whereby two groups of Middle school students were compared. The experimental group used "Thinker Tools" which allow students to manipulate computer objects that behave according to rules derived from Newtonian mechanics. The control group had studied Newtonian mechanics using traditional methods. The results revealed a significantly higher score in favour of the experimental group. Kozma (1994:8) also cites a mathematics study designed by Haneghan, Barron, Young, William, Vye, in 1990 called: "Jasper Woodbury Series". This series is a set of video disc-based problem situations in mathematics. The set provides educators and middle school students with real-world context for learning complex mathematics problem solving.

The experimental group used the video disc and worked in small groups to find a solution to problems. There were no clues nor help given to the students. This group was compared to a control group which was also subjected to the same problem. The control group was also not given guidance but instead received instruction practise in solving problems similar to those that "Jasper" (principal character in the story), would have to solve such as distance, elapsed time, fuel consumption rate, etc. The experimental group scored a mean of 58% whilst the control group scored a mean of 29%.

According to Kozma (1994:9), the study clearly indicate the "... capability of video to present complex, dynamic mental modes of those situations". However, it could be argued that other studies by Ross and Anand (1987:152), Dorsey-Davies, Ross and Morrison (1991:64) have shown that story problems contextual information improve performance.

Clark (1994:445) is of the opinion that media do not influence learning under any given condition. Clark came to this conclusion after he had reviewed the results of comparative research on educational media. He claimed that it is not necessarily the medium that influenced the learner's achievements, but rather, the method or content that is integrated with the medium. He used an analogy that "... media are mere vehicles that deliver our instruction but do not influence learners' achievement anymore than the truck that delivers our groceries cause changes in our nutrition".

Clark (1994:445), further claims that, any necessary teaching method could be designed into a variety of media presentation. However, Reiser (1994:45) asserts that certain media attributes make certain methods possible "... unless certain media attributes are present, certain instructional methods cannot be delivered effectively".

According to Petracchi & Patchner (2001:108) in a study of comparison of life instruction and interactive televised teaching, the study evaluated performance and experiences of distance learning learners enrolled in graduate level foundation social work research method course. Some learners received face-to-face instruction in a media-readied classroom whilst others received course instruction via interactive television (ITV). When their performance and attitudes were compared, it was found that there were no statistically significant differences in their assessment. The researchers, however state that ITV can be employed effectively to deliver research methods courses without sacrificing student achievement and satisfaction (Petracchi et al 2001:113).

1.2 AWARENESS AND STATEMENT OF THE PROBLEM

Mathematics learning and teaching in pre-primary and primary schools pose a challenge to many facilitators. For most facilitators especially those without good grounding in mathematics, they experience a general feeling of unease and lack of confidence.

The researcher, in her capacity as an examination moderator for Work Experience in a number of pre-primary and primary schools, became aware of the problem when visiting student-educators in their teaching experience. The researcher's focus was on the facilitators in "other" classes and not necessarily on the classes selected for teaching experience.

The researcher's interest in the topic arose from the concern over the long-term effect on the learners, due to their facilitators misconceptions and limited understanding of mathematics and of course lack of foresight in the selection and use of appropriate media in the teaching of mathematics.

Most facilitators are fully knowledgeable about the mathematical concepts, they are conscientious and able to facilitate the subject. However, frequently - through no fault of their own, some of them, like most of their educators before them were taught mathematics by drill, as a set of rules and recipes. The idea of understanding as the main goal, may have played little part in their mathematics education.

Effective instructional media can help the learners understand the meaning and massive changes in their environment. There is need for improved instructional experiences not only in mathematics but in all areas of learning.

There are two general types of instruction that is indirect personal, face-to-face instruction and instruction mediated by print, recordings, television, pictures, models, maps and many more. The effective use of instructional media must tap the powerful and undeveloped potential of the learner. For example when pre-school and primary school learners are engaged in mathematical activities they are involved in manipulating some of the concrete materials, symbols, pictures and languages.

The learners manipulate concrete material by moving blocks, various sets of toys and other objects, rods, counters, coins, their fingers and so on. They manipulate symbols by making marks on pieces of paper and arranging them in a prescribed fashion, drawing lines here and there. Filling in boxes, underlining answers and so on.

There is need for mathematics facilitators to fully utilize media in Mathematics lessons and to view the growth of understanding as the building up of cognitive connections. It is a fact that learning without making connections can be regarded as rote learning. The learner has to be helped to build up connections between new experience and previous experiences.

It can be claimed that most facilitators are exposed to media integrated learning. Some of the facilitators are good at manipulating figures for their own good but not necessarily good at imparting or facilitating mathematical concepts to the full understanding of the learners. Most learners are in constant relation and communication with their own world, the world of technology, the world of television, the world of computer managed learning systems and other resources. It is regrettable to note that most facilitators

especially in previously under-resourced schools still experience a backlog in resources such as a variety of media that would help them to make learning interesting and facilitation effective.

1.3 DISSERTATION OF THE PROBLEM

In the light of the researcher's observations as indicated above, it is clear that facilitators need to be exposed to knowledge of how to make appropriate selection of media for their lessons and knowledge of how to effectively integrate media and methods to obtain desired learning outcomes in Mathematics.

In short, the following problems will be researched: What are the significant effects of media integration in the facilitation and learners understanding of mathematical concepts in pre-primary and primary schools?

This research problem can be stated in specific terms as follows:

1.3.1 What factors influence the learners' cognitive development?

1.3.2 What criteria is used by facilitators in the pre-primary and primary schools to make appropriate selection of media for use in mathematics lessons?

1.3.3 What impact do the following factors have on media selection?

1.3.3.1 Specific outcomes

1.3.3.2 Learner variables and interest

1.3.3.3 Learning site and

1.3.3.4 Facilitators capabilities

1.3.4 What attempts are being made by educators in effecting media integration in facilitating Mathematics in pre-primary and primary schools?

1.4 ASSUMPTIONS

1.4.1 It is, in most cases taken for granted that facilitators are conversant with cognitive development theories and their relevance in learners' education.

1.4.2 Good selection of media can be achieved through good training and education, in other words, any facilitator who has had initial educator training should not find it difficult to make appropriate selection of media for his lessons.

1.4.3 If one is a good educator, one is likely to achieve one's goal with or without using instructional media.

1.4.4 It is, in most cases, taken for granted that educators use media because they are available in the school.

1.5 DEMARCATION OF THE FIELD OF STUDY

The problem of long term effect on learners due to poor performance in mathematics in pre-primary and primary schools, is experienced country-wide. The fundamental cause could be directly linked to failure by most facilitators in integrating media in their Mathematics lessons.

To conduct this research in the whole country would be impossible if one wants to get to the root of the problem and avoid superficial research results. Be it, as it may, the researcher has selected Mafikeng Region as a study area. There are presently more than twenty primary schools and about fifteen pre-primary schools in the area. Only four pre-primary schools and four primary schools in the aforementioned area will be included in this research.

It should however, be noted that the population of sample schools to be engaged in this research represents large numbers in most pre-primary and primary schools. Although the research will be undertaken in Mafikeng Region, it should be of great significance to a large number of facilitators and learners throughout South Africa.

1.6 AIMS OF THE INVESTIGATION

The fundamental aim of this study is to establish beyond doubt the effect of media integration in the facilitation of mathematical concepts in the pre-primary and primary schools.

1.6.1 The objectives are:

1.6.6.1 To investigate the factors that influence the learners cognitive development;

1.6.6.2 To determine to what extent the following factors can impact on media selection for the purpose of facilitating mathematics lessons in the pre-primary and primary schools.

Specific outcomes

(i) Learner variables and interest

(ii) Content, accuracy and relevance

(iii) Learning site and

(iv) Facilitator's capabilities

1.6.6.3 To determine the criteria used for selection of media for facilitating the learning of mathematical concepts in the said schools.

1.6.6.4 To establish the attempts that are being made by educators in effective media integration in mathematics lessons in pre-primary and primary schools.

1.7 METHODS OF RESEARCH

1.7.1 Three methods of research will be used, namely:

(i) a questionnaire (survey)

(ii) observation of lessons presentations

(iii) interviews

1.7.1.1 Questionnaire (survey) method

The foundation of all questionnaires is the question. The questionnaire must translate the research objectives into specific questions. The responses to such questions will be analysed to provide the data. The questions must be phrased in such a manner that the respondents are motivated to supply the necessary information (Nachmias and Nachmias 1981:209). However, it must be noted that the questionnaire that is not properly designed can produce a fundamental source of bias in the ultimate results of the survey (Denzin 1989:145). The questionnaire should be fully structured, that is, questions should be asked in predetermined sequence using identical wording.

There is need to avoid bias in questionnaire construction. Such pitfalls include **inappropriate wording of questions**. The vocabulary used should be understandable by all intended respondents. The question should have one and the same meaning for each respondent unless the objective is to assess differentials in meaning. Another pitfall is the **leading question** whereby the researcher is perceived to expect a certain answer. Leading questions are to be worded and phrased in such a manner that they do not appear to be

emotionally loaded. The tendency is for the respondents to react not so much to the issue posed by the question as to the loaded phrase itself (Nachmias et al 1981:225).

One other pitfall is the use of **threatening questions**. According to Bradburn, Sudman, Blair and Stocking (1978:229) the researcher needs to determine which are the threatening questions and rephrase them in such a way that they do not produce biased responses. The respondents could be requested to classify their responses in given categories

In this study, the questionnaire is designed with close-ended questions. In close-ended questions, the respondents are offered a set of answers or statements from which they are asked to choose the one that most closely represents their views.

Close-ended questions are easy to ask and quick to be answered. They do not require any writing by either the respondent and the interviewer. Their analysis is straightforward. Close-ended questions require less motivation to communicate a response on the part of the respondent. Close-ended questions are suitable when the researcher's objective is to get the respondent to express agreement or disagreement with an explicit point of view, but if the researcher wants to know more about how the respondent came about that view, then open-ended question is more appropriate (Nachmias et al 1981:213).

1.7.1.3 The observation method

The main quality of observation is its directness. It enables a researcher to

study behaviour as it occurs. It deals with the overt behaviour of persons in appropriate situations. All what the researcher does is to watch the subjects do and say things. The researcher gets first-hand data that are uncontaminated by factors standing between the researcher and the subject(s) of research (Nachmias et al 1981:158).

The outstanding requirement for observation is to know the behaviour that is being observed and the ability to concentrate and being focussed, since a limited knowledge may cause or lead the observer to miss out on many important aspects. According to Nachmias et al (1981:159) there is need to have a framework for describing the observed behaviour. They also maintain that it is possible to observe a child talking and interacting with another child or adult and describe many important and interesting aspects of the situation, but not provide information that is necessary for understanding what the child knows.

Observation may take place in a natural setting (De Vos 1998:280). Observational methods might be used in cases where subjects are not willing to co-operate with the researcher or in some cases where subjects are unable to express themselves verbally. The observer can get a clear picture of what is going on by observing the subjects in their familiar environment. The researcher is able to observe how the observed interact with their environment (De Vos 1998:280).

Observation may take place in a laboratory where sophisticated devices such as one-way-vision mirrors or screens, video cameras and audio-introspectormeters can be used (Nachmias et al 1981:157).

Laboratory observation is the most controlled method of date collection (Nachmias et al 1981:169). It involves introduction of conditions in a controlled environment. Observations in a laboratory are recorded on the spot during the experimental session. After the observatory exercise, the units of observation are assigned to a well-structured category system.

In some cases, the researcher might take part in the activities of the observed. The researcher then becomes a participant observer (Denzin 1989:118). In a case like that, the researcher attempts to share the world view and adopt the perspective of the people in the situation being observed (De Vos 1998:279). In other words, the observer wants to get to know more about the observed by "acting" as one of them. In most cases the observer conceals his role as an observer and records his observation in secrecy (Nachmias et al 1989:173).

1.7.3 Interview method

An interview is a face-to-face verbal interchange in which one person, the interviewer attempts to illicit information or expressions of opinions or belief from another person or persons (De Vos 1998:297). Interview is like a conversation. Conversation is a give-and-take between two persons or more. It is an informal interchange of thoughts by spoken words (Denzin 1989:12). The basis of interview is "talk" and its social organization (Powney & Watts 1987:7).

According to Powney et al (1987:2) interview is one of the methods that is mostly used within psychology and least utilized within the theory of sciences. The ability to interview effectively cannot be taken for granted. The interviewer needs careful preparation and practice to develop sound and recording skills

as well as the ability to analyse and evaluate the data collected (De Vos 1998:301).

Douglas 1985 (Denzin 1989:109) talks about creative interviewing, that creative interview is dependent upon attentive listening, he further states that the creative interview impinges on another person's world and building a trusting relationship with that person. It involves the capacity to be quiet and to sympathetically identify with another's point of view. Persons can only share experiences with each other if they listen to one another (Denzin 1989:109).

Powney et al (1987:7) are of the opinion that an interview is based upon talk and that data could be gathered through direct oral interaction. The exercise involves the person who asks questions and how he/she phrases the questions and on the other hand, is the person who answers the questions.

There are three forms of interviews, the schedule standardized interview, the non schedule standardized interview and the non standardized interview. In the schedule standardized interview (SSI) the wording and order of all questions are exactly the same for every respondent (Denzin 1989:104). All the questions are comparable. The differences in their responses cannot be attributed to the instrument but to the apparent variations between the respondents themselves. In this case, the natural settings will be the classrooms. The aim is to get first-hand information about the activities in the classroom.

1.8 RESEARCH TOOLS

The study will include a questionnaire, observation of lessons presentations and interviews.

1.8.1 QUESTIONNAIRE

A self-developed questionnaire (on the basis of literature study) will be completed by seventy (70) educators (N=70). This number will include eight educators (N=8) who will be presenting twelve (12) mathematics lessons for observation.

Only educators with more than three year teaching experience, will take part in the research study. The researcher has chosen this category of educators because there are quite a number of them in the pre-primary and primary schools who are experienced but not qualified and some are under-qualified.

By means of the questionnaire, data will be gathered to establish the following:

(a) What the nature and characteristics of media should entail in the facilitation of mathematics in pre-primary and primary schools.

(b) The criteria used for selection of media for use in the facilitation of mathematics in the pre-primary and primary schools.

(c) The attempts that are being made by educators in effecting media integration in the facilitation of mathematics in the pre-primary and primary schools.

The data collected by means of the questionnaire will be computer processed (See annexure "A" for the questionnaire).

1.8.2 The empirical research will include:

* Presentation of mathematics lessons by the educators in the pre-primary and primary schools to determine the following:
* the nature and characteristics of media employed in their lessons.
* selection and integration of media in their lessons.
* The specific outcomes, content accuracy and relevance, the learner variables and interest, the learning site and the mediation capabilities of the facilitator.

The researcher will design an evaluation instrument to obtain feedbacks in the areas as suggested above (See annexure "B").

1.8.3 <u>Population</u>

The total number of lessons to be evaluated for both pre-primary and primary schools will be twelve (12). Because of large numbers of learners in the local primary schools, the researcher will request the principal of the school to allow, at the most thirty (30) learners in a class to participate in the lesson. That arrangement will not affect the pre-primary schools because the numbers are controlled. Each educator will be required to submit, on the day of presentation, the lesson plan, indicating the following:

* The lesson topic
* Time
* Specific outcomes
* Content

* Relevant media
* Method of facilitation
* Conclusion

The lessons will be analysed to obtain data. A five point scale evaluation instrument will be designed to capture and rate the following:

1.8.4 Observations

* prior subject matter knowledge
* mathematical ability
* reading and understanding of instructions
* accuracy of content
* relevance of specific outcomes stated or implied

1.8.5 Media used in the lesson

* type
* appropriateness
* aroused/maintained interest
* technical quality
* helped to promote participation/involvement
* evidence of effectiveness
* cost effectiveness in terms of pupil achievement

1.8.6 Learners performance

* did they show interest in the lesson?
* participation and involvement
* display of capabilities/understanding

1.8.7 Class facilitator's presentation and mediation capabilities

* clarity of specific outcomes
* appropriate vocabulary usage
* meaningful organisation of content
* integration of media in lesson

The questionnaire data and observation data of the empirical study, will be integrated in order to determine the extent to which specific outcomes, learner variables and interest, content accuracy and relevance, learning site and mediation capabilities of the educator can impact on media selection for use in the facilitation and learning of mathematical concept in the pre-primary and primary schools.

1.9 DEFINITION AND ELUCIDATION OF CONCEPTS

1.9.1 Media

Media are channels of communication derived from a Latin word for "between", the term refers to anything that carries information between a source and receiver.

McLuhan (1964:130) sees media as "extensions of man which allow him to affect other people who are not in face-to-face contact with him. The extensions include among others, television, telephones, cellular phones, films etc, with which one man can reach out to another.

According to Heinich et al (1990:14) the role media is to convey messages with an instructional purpose, that is, to facilitate communication. Media in education act as supplemental support of the educator. Properly designed media help to enhance and promote learning.

1.9.2 Instructional Media

It is any medium which carries messages with an instructional purpose (Kemp 1978:14). In any facilitation and learning situation there is a message to be communicated. The message, in most cases may be directions to the learner or instructions on how to go about the subject matter content (Tomlinson 1981:92)..

An object becomes a medium of instruction only by assuming a specific function, for example, if television has to be used as a medium of instruction, it has to serve a particular purpose rather than if one deals with it as a television box that emits pictures and sounds (Gerlach & Ely 1971:298). Instructional media should make a substantial contribution to the achievement of the objective of the lesson (Kruger, Oberholzer, van Schalkwyk and Whittle 1983:266).

1.9.3 Pre-primary school

A pre-primary school is a centre or site where a group of 3-6 year old receive formative education in an informal yet purposeful planned and organised manner. The learning areas (subjects) are not demarcated as in the case of primary schools (van Schalkwyk 1988:122).

The programme includes concepts such as music, movement, language, number of numerical concepts (mathematics) art, religion, health education etc. Pre-primary education complements what the child learns at home and continuity between home and school is therefore important.

1.9.4 Primary school

A primary school is a centre or site where learners aged 6-12 years of age receive formal education. The education offered is elementary (Farrant 1980:283). It lays a foundation and is of a preparatory nature. It provides for every person's basic right to literacy. It is, in most cases compulsory and free to everyone in some countries. Primary schools offer the learner's general, broad and basic education. It lays a foundation for secondary education (van Schalkwyk 1988:123). The purpose of the primary school is to introduce the learner to various skills of reading, writing, mathematics, studying and being independent, the culture of his community, sports, science, religion, moral education etc.

1.9.5 Teaching/Facilitation

Teaching involves the skill and ingenuity to reconstruct the curriculum, redesign the environment and change one's behaviour so that one's learners will have the experiences, resources and support they need for development. It is an art of helping the learners to develop sensitivity, compassion and intelligence. Teaching occurs in any instructional situation. It involves the educator, the learner and the subject matter or the content as is widely known. It is obvious that in any facilitation and learning situation, morals and values will be part and parcel of the exercise (Krech et al 1982:665).

It is the ability to observe and discover learners' skills and needs and build a learning environment that is centred from them and does not violate them. The educator has to be responsible to the learners rather than depend entirely on the curriculum.

The craft of learner-centred teaching has to do with guidance of a learner in his early interaction with the world around him and with himself (Farrant 1984:129). Teaching should attempt to give a learner a feeling of belonging to the physical and social world and to encourage involvement in and responsibility towards it (Entwistle 1970:158). The educator should help the learner to enjoy success, to accept and give criticism, to develop creativity and aesthetic awareness and to be at peace with himself.

In this study the focus is on the facilitation of mathematics with the help of resources. Teaching in this case has to do with developing the learner's capacity to gain deeper understanding of his physical and biological surroundings. The learner has to be helped to develop and apply practically an understanding of mathematics. An attempt has to be made to integrate concrete experiences with creative arts and to use media to its fullest in order to convey the mathematics concepts that the learner is expected to know.

1.10 THE PROGRAMME OF RESEARCH

CHAPTER 1

This study consists of six chapters. The first chapter holds as content, the introductory orientation to the study which states briefly the literature on the utilization of media in lessons. The chapter also captures the researchers awareness of the problem of research. The statement of the problem reads: The integration of media in the teaching of mathematics in the pre-primary and primary schools; the demarcation of the field of study; the purpose of the study; it further explains the method to be adopted; the definition and elucidation of concepts and the programme of research.

CHAPTER 2

Chapter two deals with the review of literature on concept formation and cognitive development. A detailed account of learning and how learning takes place will be discussed. Another detailed account of cognitive developmental theories will be discussed to establish their contribution to the child's mental development. Concepts such as conservation of number, length, volume space etc., will be explored. Fundamental mathematical ideas involved in the process of measuring such as, comparison; ordering will be addressed.

CHAPTER 3

Chapter three deals with a variety of media available in schools under the following main headings: Instructional media, a variety of methods used in lesson presentations. Designing visuals, non-projected visuals, projected visuals and technology used in education.

CHAPTER 4

This chapter focuses on the selection of appropriate media for integration in the teaching of Mathematics. The following factors are taken into consideration: Guidelines for media selection, with special reference to objectives, content consideration, the learning environment and the learners' characteristics. The improvisation of media by the class educator in his/her lesson also forms part of the discussion.

CHAPTER 5

In this chapter, the research methods are discussed. The eight teachers from the selected eight schools are subjected to an investigation, to try to establish beyond doubt as to whether integration of media in the teaching of

mathematics at Pre-primary and primary schools, help to arouse and capture the learners interest and attention as well as foster cognitive development and problem solving skills. Sixty educators including the eight educators already mentioned in this chapter will complete the questionnaire.

CHAPTER 6

This chapter comprises the analysis and interpretation of research results, conclusions of the research and recommendations for future research.

CHAPTER TWO

2. LEARNING, CONCEPT FORMATION AND COGNITIVE DEVELOPMENT

2.1 INTRODUCTION

For the purpose of this investigation into media integration in the facilitation of mathematics to young learners, the researcher has found it necessary to first highlight how young learners learn and how their interaction with their world impacts on their cognitive development. Conceptualisation with special reference to the variety of concepts such as physical sensory concepts, action-functional concepts, evaluative concepts and abstract concepts will be discussed. This will be followed by a detailed account of cognitive developmental theories that will establish their contribution to the young learner's mental development.

Piagetian cognitive development will form a basis of the discussion. This will entail mental operations and developmental stages, concepts such as development of number concepts, will be explored. The fundamental mathematical ideas involved in the process of classification, seriation and comparison will be discussed.

Views expressed by Jerome Bruner (Tomlinson 1981:99) concerning progression from inactive to iconic and finally to symbolic will be addressed. This will be followed by Sternberg's (1984:19) view of cognitive development which features meta-cognition, that is a persons, knowledge of his mental abilities and the factors that influence thinking. Gardner's (1983:289) cognitive theory of multiple intelligence will be discussed. He postulates the view that the mind is organised in terms of relatively independent realm of functioning

and that these realms of functioning could be referred to intelligence. The discussion will also touch on the views expressed by Reuven Feuerstein which lay emphasis on the need for a mentally challenged child to be helped "to go beyond himself" (Sternberg 1984:59). That such a child needs an adult intervener, a mediator and a motivator who can arouse or awaken him to function intelligently. Finally, Carl Haywood's (1997:8) approach to cognitive development will be discussed. He, like Feuerstein believes in mediated learning whereby the child is helped to learn how to learn and to learn how to think.

2.2 Learning

The concept 'learning' has many definition. There is no single definition that is universally acceptable as most educators like Howe (1980:115) has stated. It is impossible to define learning clearly and unambiguously in such a manner that makes it possible to distinguish between learning in its varied forms and some other causes of change in a persons behaviour.

Learning is an active process. It presupposes active involvement by the learner in the act of learning before it can take place. This means that no person can learn for the other. Therefore it is only when a person learns that one can speak about the act of learning. In supporting these views Nicholson and Lucas (1984:62) claim that learning is something done by people it cannot be done to them. You can help others to learn, but you cannot make them learn. A person learns only if, and to the extent that, he himself participates in or responds to the conditions which make up the learning situation. The more he responds and the more intense his motives for responding, the more he learns.

Learning could be defined in varying ways according to the theoretical learnings of the person offering the definition. The following are some of the definitions of learning according to some educators: Learning as defined by Tomlinson (1981:103), is a process whereby capacities or tendencies change as a result of action or experience. Learning is a change of behaviour. When learning has taken place, the results of learning are observable. The learner knows something or can do something that he or she did not know or could not do before. Much as learning leads to a change of behaviour not all performances are a result of learning.

Some programmes are a result of growth and maturation. According to Papalia and Olds (1988:160) learning cannot be attributed to ability or skill that is attained as a result of maturation, also excluded are reflexes because they are 'wired-in' by heredity. However, psychologists generally assess what people have learned on the basis of what they do. Behaviour is the only criterion that can be observed and measured.

Bugelski in Duminy, Dreyer and Steyn (1990:136) say that "Learning is a mental activity by means of which knowledge and skills, habits, attitudes and ideas are acquired, retained and utilized resulting in the progressive adaptation and modification of conduct and behaviour."

Kalunger and Kalunger (1984:41) are of the opinion that learning is a process by which knowledge, skills and values characteristics are acquired and that learning provides the know how and the know why of doing things.

Papalia and Olds (1988:159) maintain that learning is a relatively permanent change in behaviour, which reflects a gain of knowledge, understanding or skill achieved through experience, that may include study, instruction, observation or practice. Changes in behaviour are reasonably objective and therefore cannot be measured.

2.2.1 The types of learning

Researchers agree that it is possible to distinguish among the different types of learning since learning takes place in a variety of ways. Although they may differ, the different types of learning are related to and built upon one another.

Coppedge and Exendine (1987:106) state that "Learning refers to the acquisition of academic information and skills and the exercise of appropriate behaviour. Both are to be learned in the classroom".

2.2.2 Meaningful learning

Ausubel, Novak and Hanesian (Tomlinson (1981:125) make a distinction between rote learning and meaningful learning. Rote learning is learning 'by heart', memorizing new material in an abitrary and superficial way. Meaningful learning on the other side, occurs when new material is linked by the learner to the relevant ideas and conceptual schemes he already possesses in his existing cognitive structures. Ausubel contends that meaningful learning is more effective than rote learning. He asserts that meaningful learning makes the learning processes more effective by affecting it at all the three main phases that is, acquisition, retention and retrieval.

Learning comprises the imprinting of the material being learnt, that is, meaningful learning is essential. This material is not only academic but may comprise the imprinting of norms, values, moral codes, attitudes, habits and various skills. The newly acquired knowledge may add to the knowledge previously acquired by the learner, be it a refinement of it, a replacement of it or may be something new altogether which has no link whatsoever with anything previously acquired.

The individual receives information. This information is allowed to pass from the sensory store to the short-term store, during which the individual actively organizes it through rehearsal (Krech, Crutchfield, Livson, Wilson and Parducci 1982:252). At this stage we say imprinting or learning occurs in order to promote the storing or retention of the information in the long-term store. During this more or less conscious imprinting, structural and or chemical changes occur in the brain, affecting short-term or long-term storage of information. This is called memory information which is normally not a complete reproduction of the information received because of present and future intervening factors. It is assumed that these events, which can be investigated on a psychological level, are accompanied by certain brain events. (Jordaan, Jordaan and Niewoudt 1975:643, 741; Hilgard 1966:100). For the learner to be able to retain and retrieve acquired learning two basic forms of activities should not be neglected, that is, (a) Practice or retest, in which the learner tries to carry out what he or she has tried to learn. (b) Review, in which he or she goes back over the material or process designed to result in learning. According to Vrey (1979:221) learning is a matter of retention or memorization of what had been learnt a long time ago without being tested frequently, will be inefffective or easily forgotten.

According to Van Aswegen (1979:53) learning produces relatively lasting results. When it produces a result, the behavioural potential of the learner changes. The change proceeds from a state of ignorance, inability or incomprehension to one which the learner knows, has the ability to do something and comprehends - meaning that something has been grasped. What we need to know is that capacities and tendencies correspond in psychological items to cognitive learning and motivational learning respectively (Tomlinson 1981:104).

2.2.3 Motivational learning

Motivational learning is the acquisition of preferences and the tendencies to do things, act, react, think etc. in particular ways. Motivational learning has to do with "learning to" acquire knowledge or mastering a skill that the activity is designed to teach. According to Keeves (1986a:135) motivation to learn refers to the learner's resolve or intention to put in some effort to perform a learning task. In any learning situation, motivation has an important role. The facilitator can motivate the learners by showing some amount of interest and enthusiasm and zeal for all the lessons he/she presents by making the lessons interesting and by using relevant media to capture the learners attention. Another factor that plays a role in motivational learning is facilitator learning-relationship Personal contact or a climate that emphasizes positive interactions between the facilitator and learner leads to building self-esteem in learners. Self-esteem is how one feels about oneself and one's values. Learners are sure to be actively involved in lessons when fully motivated and the likelihood is that their performance will be highly rated (Schultz, Glass and Kamholtz 1987:433; Levine 1988:23; Amudson 1991b:1-3).

2.2.4 Acquisition of factual knowledge

Acquisition of knowledge has to do with people learning facts as well as their interrelations. The essential element in the acquisition of factual knowledge is the assimilation of unique and fortuitous data - fortuitous because, logically speaking, they could have been different (Vrey 1979:243).

There are certain facts which contribute to the development of the learner which every learner ought to know. For example, facts from learning areas such as mathematics, numeracy, language skills, natural sciences and so forth. Facts may help to promote insight, but that is not the primary reason for imparting them to the learner. They are regarded as worth knowing for their own sake. They could come in handy as the learner continues to interact with the world around him.

2.2.5 Memorization

It implies rote learning whereby the learner practices and repeats over and over again, material that has to be learned and later reproduces what had been practised. In most cases rote learning is not meaningful to the learner. When a learner has memorized something, he is able to reproduce it verbatim (Tomlinson 1981:106). Here the emphasis is not on understanding facts, but on memorizing particular expressions, maxims and formulae (Farrant 1984:112). Memorization helps the learner to remember what he/she has experienced and it forms a base for all further behaviour (De Witt and Booysen 1995:54)..

2.2.6 The development of automatism

This is a completely different type of learning. When the learner learns to write

or to play chess he is engaged in yet another totally different form of learning. In this case he is learning to execute various physical movements. One of the characteristics of this type of learning is that, once a person has gone through the process, and mastered it, he no longer needs to think about the actions involved - the movement comes naturally. In the psychology of learning, movements such as these are termed automatisms (Vrey, 1979:244). Some of the things learned, that way are, bicycle riding, driving, swimming etc.

2.2.7 Observational learning

In observational learning a person learns from interaction with other people in society. By watching other people, one learns new responses without first having had the opportunity to make responses oneself. A person learn by imitating the behaviour of socially competent models. Specific skills can be learnt by watching other people carry them out for example to cook, sew, play tennis and other related skills. One can also learn a great deal more simply by seeing and listening to others. Learning based on observation and imitation of models is called observational learning (Hughes and Hughes 1967:112). Observational learning is based on interest and attention. Young children are ready by nature, to attend to a large variety of stimuli Piaget (Farrant 1984:108).

2.2.8 Association learning

In this type of learning new associations between two events are formed. There are two basic types of associative learning, namely classical conditioning and operant conditioning. Classical conditioning allows us to predict the arrival of an important stimulus and that increases our ability to

survive. Operant conditioning allows us to do something to get what we want or need, and this is another step in adaptability (Papalia et al 1988:160).

2.2.9 Concept learning

This involves learning to sort objects on the basis of their similarity or commonality and distinguishing between parts of the whole, as well as superordinate and subordinate classes (Tomlinson 1981:117). Concept learning will be discussed in full later in this chapter.

2.2.10 Cognitive learning

Cognitive learning is the experiential acquisition of capabilities such as, "learning how", that is, one is able to perform this and that, in other words one knows how to do certain things or activities (Faber and van Staden 1997:34). The process of learning begins with the acquisition or grasp of what is involved. A feature of the acquisition of knowledge is that, people learn facts as well as their interrelations. The essential element in acquisition of factual knowledge is the assimilation of what has been learned (Krech et al 1982:293). Cognitive learning is seen as an advanced mode of gathering information about the concept around us, and the ability to be aware of one's experiences as they occur and being able to adapt one's self with a view for future experiences (De Witt 1995:49).

The learner himself does not know what has been anchored into his cognitive structure until he tries to recall or actualize it. Jordaan et al. (1975:643-644) illustrate this aptly when they say that learning cannot be observed directly, but changes in behaviour may be observed. For instance, an educator might,

discover by means of a test if his/her learners have or do not have knowledge of a given subject.

2.3 CONCEPT FORMATION

Concept formation and cognitive development will help the educator to know the learners' level of intellectual development and to know how to match media available in their schools to suit learners of a particular level of development. The levels are as follows: concrete level, identity level, classification level and formal level.

2.3.1 Concrete level

At this level a child needs to remember the name of the concept or label. Concrete usage seems to require recalling of a set of distinctive features. In most cases the child is often faced with physical changes in the appearance of significant social figures (Santrock 1983:198) for example a child picks up his/her mother from a group of other women.

2.3.2 Identity level

Here recognition of the thing in question may take various forms into consideration. At the identity level, the child can recognize his mother from her features, her voice, her smile, her caring, her complexion and so forth. The child treats these different features as relating to the same individual, that is his/her mother. Identity is the feeling or meaning that an individual attaches to himself or the physical and social attributes that an individual attaches to another person (De Witt et al 1995:113).

2.3.3 Classification level

At this level the capacity gained from concrete and identity level enables the child to see two or more instances of a concept as equivalent in their being exemplars of the same category, but without being able to describe the basis for this classification. This is like drawing inference, the ability to relate one event and another, that is not directly stated (Santrock 1983:292). For example the child may see that his mother is the same as Kedibone's mother (both have fuller bodies) but not the same as Gomolemo's mother (she is slim).

2.3.4 Formal level

Here, in additional to the previous capacities, the child is able to specify and name the defining attributes of the concept using some sort of symbolic or language to narrate what he sees and observes, eg. "Mummy is tall" (Krech, et al 1982:300).

2.4. CONCEPT LEARNING

According to Tomlinson (1981:68) there are a variety of concepts such as physical-sensory concepts, action-functional concepts, evaluative concepts and abstract concepts.

Physical-sensory concepts are concepts that are defined according to their physical attributes such as loudness (can be heard), length (can be measured) colour (can be seen), strength (can be felt) and so forth. Not all concepts have physical attributes, for example, action-functional concepts involve classification and categorisation on the basis of what is being done and the purpose linked directly to that action, or a thing or event in question (Baldwin and Baldwin 1970:30). Thus in the case of "chopping up" one can easily

recognise that "chopping" is an action that can be carried out by means of a sharp instrument such as an axe (concept) for chopping wood or a knife (concept) for chopping vegetables and so forth. Concepts of this kind clearly indicate that classification and categorisation is dependent on an individual (Tomlinson 1981:68).

Evaluative concepts vary in many subtle ways. The tendency is for them to differentiate and discriminate on the basis of positive and negative reason of an individual. For example, some people discriminate on the basis of like and dislike, desires and aversions and so forth. Some concepts are abstract. They refer to things that cannot be touched or seen, such as love, thought, grief, power, kindness and so forth.

2.5 FACTORS THAT INFLUENCE CONCEPT LEARNING

Concept learning is highly dependent on the characteristics of the learner, taking his age and level of development into consideration (Tomlinson 1981:105). This is confirmed by Piagetian developmental progression through the various stages.

Older children find concept learning easier in the beginning and progress to master increasingly complex and abstract concepts. They are able to apply learning strategies available with age (Krech et al 1982:161). It is further emphasized by Vygotsky (Clark-Steward, Friedman and Koch 1985:25), that concept learning both affects and is affected by cognitive development.

Factors that have to be taken into consideration are the characteristics of the concept. For any concept to be successfully learned one has to be aware of

its features, the number of attributes and values that the concept has, affects their difficulty in learning (Spodek 1985:34). For example certain concepts that are abstract can easily be conveyed by examples than by verbal definition like in the case of grief, truth; happiness and so forth, whereas concrete concepts can be explained in terms of shape, size, colour, weight and many other concrete features.

Klausmeier, Ghatala and Frayer (1974:85) add that the characteristics of instructional procedure is yet another factor that influences concept learning. Teaching can be effectively carried out by means of verbal or other symbolic definition. According to Bolton (1977:117) learners find it easier to use positive information in concept learning than negative information.

2.6 COGNITIVE DEVELOPMENT

Cognition has to do with what a person thinks, his ideas, convictions, understanding and knowledge (Tomlinson 1981:55). Cognitive approaches to learning lay emphasis on changes that occur in the cognition of a person during the learning process, as such learning is seen by cognitive psychologists as an advanced non-automatic method. Clark-Steward et al (1985:350) and Siegelman & Schaeffer (1991:200) believe that cognitive development has to do with the infants interaction with his/her life world. Cognitive development among other things includes the functions relating to perceptual memory, intellectual development as well as linguistic development (De Witt et al 1995:49).

2.7 PIAGETIAN VIEW OF COGNITIVE DEVELOPMENT

Cognitive development is clearly deliberated upon by Jean Piaget, the master

and most influential psychologist of his time. According to Sovchik (1989:17) and Berk (1991:22) Jean Piaget was the first to identify mental operations and stages of development which provided specific research direction for the modern developmental psychologists. It is generally agreed by most psychologists that cognitive development has to do with the infants interaction with his/her world (Berk 1991:22). Piaget's general development principles such as equilibration, assimilation and accommodation attempts to explain what determines what an infant does and why he/she acts in a particular way during a particular level of cognitive development.

Piaget (Copeland 1984:405) believes that the mental life of a child consists of an organised system of ideas about self, other people and things in the environment and about abstract ideas. According to Piaget as the child physically interacts with people and things within his reach, he develops a complex understanding. This exchange or interaction with his environment is referred to as adaptation. As the child progresses, his mental structures become intrinsically motivated to improve his functioning at a higher level. Piaget refers to that tendency as equilibration, that is, the motivational basis for cognitive growth, (Meyer & Van Ede 1990:51). The child grows, develops matures, and learns because of a genetically compelling push for equilibration with the environment. This is conformed by Kennedy (1971:179).

According to Piaget, some of the functions that feature in the cognitive development of a young child are two types of adaptation complementary. In assimilation, the child tends to take it from the external environment whatever impinges upon him and utilizes it (Maier 1978:22). However it must be stated that Piaget asserts that the child or infant is selective in that he tends to take

only those aspects of environmental stimulation that he is able to handle. In other words, the infant tends to perceive only things that make sense to him in terms of what he already knows. If the child is confronted by a new object or thing which does not make sense to him he tries to incorporate its features by slightly modifying his cognitive organisation to accommodate it (Santrock 1983:44). Accommodation is the type of adaptation that complements assimilation. It is a type of adaptation whereby existing and new schemes are formed or the existing old ones are modified or together they are combined to being about complex cognitive growth or organization (Krech et al 1982:293).

It is important to note that in taking new information or insights, the infant also accommodates himself and changes what he has grasped, to fit in with the new knowledge. These interaction aspects of cognition have some far reaching implications for meaningful learning and teaching.

All concepts portrayed by Piaget indicate that there is continuous mental growth and development that helps the child to adapt to his environment. It might be perceived that mental growth and development would proceed smoothly and gradually along a continuous course. It is however interesting to note that Piaget instead suggests four major stages in development and that each stage represents a discrete and qualitative step upwards from the preceding one. The stages are invariable in the order of their occurrence for all children, although the ages at which they are achieved may vary considerably from individual to individual (Clark-Steward 1985:308) the stages are:

(i) Sensory motor stage (birth to 2 years)

(ii) Pre-operational stage (2 to 7 years)

(iii) Concrete operational stage (7 to 11 years)

(iv) Formal operational level (11 year upwards)

The researcher will not deliberate on all the stages as stated above. Only two stages will be fully discussed that is, the pre-operational stage and the concrete operations stage The reason being that the two stages are relevant to the topic of research.

2.7.1 Pre-operational stage : 2-7 years of age

During this stage most children do not utilize concepts. Their reasoning tends to be illogical or it could be said to be transductive reasoning (De Witt et al 1995:17). They reason from particular instances to particular instances. An example of pre-conceptual thinking can be demonstrated by a young child who sees a toy similar to the one his mother bought for him, can hardly be blamed for insisting that he be given "his toy". The child spends most of his waking hours in playing. Play forms a most important part of a growing child (Rogers & Sawyers 1990:1). It is through play that he makes sense of the world surrounding him and is continuously establishing new realities for himself. As the child plays he explores and discovers many things around him and he becomes familiar with them. In that way he learns through exploration (De Witt et al 1995:56). As the child's cognitive functioning appears, he develops recognition of objects as well as disillusionment of failure (De Witt et al 1995:57). The child's verbal ability enables him to ask questions about things in the world surrounding him and thereby establishes reality within his scope of consciousness. He names the objects that are in his life world thereby being able to identify and give reality to things through language (Hymes 1968:84). There is however, the tendency for children to

overgeneralise or over-regularise in their application of some grammatical morphemes (Tomlinson 1981:203). For example once the child has the idea of inflicting with an - "ed" suffix to product past tense the tendency is to apply it for a while to all verbs including "eated", "drinked" and many more. When the child reaches ages four to seven years, that period is regarded as intuitive thought. It is a period of internalization by means of images and mental experiences (Gelman 1978:69).

After the age of four, the child gradually develops logical thinking although his thoughts are dominated by perceptual appearances rather than logical thinking (De Witt et al 1995). The child is highly egocentric at this stage. This is demonstrated by many experiments that illustrate that the child can only understand his experiences with reference to himself. Some experiments have shown that a child of five or six is still incapable of describing how a scene would look if viewed from any angle other than his own current view. He finds it difficult to conceive that the scene can look any different from the way it looks to him (De Witt et al 1995:17; Phillips 1982:75).

Egocentrism can also be illustrated by asking the child to place wooden beads in one of the two containers provided by the experimenter. The containers could be a flat dish and a narrow tall glass. The child is given the glass and the experimenter a flat dish as the child places a bead in his container the experimenter does the same by placing a bead in the dish. If asked who has more beads or whether they have the same? The child would probably say that he/she has more, because of the glass or she might say the experimenter has more because the beads in a dish cover a wider area. In both cases her response would be based on perception.

It is during the intuitive period that Piaget (Krech et al 1982:281) came up with a phenomenon that he calls centering. That is, the tendency for a young child to focus upon a particular aspect or quality of an object or situation. This is a clear indication that a child fails to master the principle of conservation. When concentrating on a particular characteristic of an object, let us say, its shape, he fails to realize that other characteristics of the same object can remain constant, despite highly visible but actually irrelevant changes in the features that he has concentrated or centred on. For example a young child does not realize that a mass of clay will weigh the same whether flattened or rolled into several balls or elongated into a roll or two rolls. A pre-operational child believes that transformations change the amount of clay (Clark-Steward 1985:322).

Another striking characteristic of the child's thinking during intuitive period is his inability to classify. Piaget's classical experiment illustrates this. A five-year old child is shown a collection of wooden beads of which ten are brown and five are yellow. He admits that all beads are wooden but when asked whether there are many or fewer or same number of brown beads as wooden beads he is likely to say there are more. The same error of classification would apply when the child realizes that most of the flowers are daisies and fewer are tulips but answers "Daisies" to the question: "Are there more flowers or more daisies?" Piaget's explanation of this phenomenon is that when a child is asked to consider the subclass, this destroys the larger class for him. The child understands that classes may contain many different but similar members but cannot get to understand that classes can be arranged one inside the other, each being separate but related, like in the case of wooden beads.

Intuitive period can be summarised as a stage that is highly dominated by egocentrism and perception as well as prone to errors of classification and the inability to seriate. Children at this stage have not yet fully mastered the principle of variance of conservation. However it must be borne in minds that development does not occur to all children at the same time, some children are able to conserve as early as six or seven years (Krech et al 1982:295).

2.7.2 Concrete operational stage: 7-11 years of age

Concrete operational stage is said to be the beginning of genuine thought (Halford 1979:14) which Piaget refers to as the beginning of operations. An operation is an internalized action, which is reversible and governed by laws which apply to the system as a whole.

Conservation is regarded as a hallmark of concrete operation (Gelman 1978:73). A correct response to a conservation problem not only marks the end of the operational period but also signals the beginning of concrete operational thought (Sovchik 1989:19). The realization that quality or amount remains invariant when nothing has been added or taken away from an object or a collection of objects, despite changes in form or spatial arrangement (Starkey, Spelke and Gelman 1990:102) is an indicator that the learner can conserve (Anselmo 1987:384; Tomlinson 1981:195).

In general, concrete operational stage is characterized by a greatly increased ability to represent relations between elements of a task. There are quite a number of conservations as there are perceptible quantitative attributes or properties of objects. There is conservation of number and length both mastered simultaneously by all children. Some children are slow to catch up

and others are fast. It must also be noted that some conservation such as that of volume might not be acquired by some children until at a late period (Krech et al 1982:295).

2.8 COGNITIVE FUNCTIONING OF THE YOUNG CHILD

2.8.1 Development of number concept

Children often come to the pre-school "knowing" how to count. They recite the names of numbers in sequence without any understanding of the idea of the number that corresponds to a given name or numeral (Copeland 1984:106). That act is regarded as rote learning because that type of counting has no significant value with the development of number concept (McEvoy 1989:107).

According to Fuson and Hall (Starkey et al 1990:98) recent research questions this outright dismissal of the contribution of counting to the development of number concepts. They state that during the initial number word acquisition, the number word and meaningful counting merge and interest in powerful and sophisticated ways. Most educators support the idea that young children need experience that help them associate names or symbols with the number they represent. Counting has been viewed by most educators of young children as a basic skills that is easily accomplished and learnt mainly through nursery rhymes and through play (McEvoy 1989:10).

Children exposed to efficient counting procedure, are likely to discover or construct number concepts (Gelman and Gallistel 1978:204). The ability to count develops in a hierarchical manner and through practice, counting gradually becomes automatic and get integrated into a network to form more complex numerical skills. Klahr and Wallace (McEvoy 1989:07) in their mode,

Schaeffer Eggleston and Scott (1974:377) came up with the skill they refer to an "enumeration", that is, the ability to assign a number word label to each object in a set. In accurate counting, each countable object or item is paired with one and only one sequence word. Counting number words sequentially begins at the age of two years for some children. Most three year olds can produce longer correct conventional sequences up to ten (10) than some five year olds. Children between four and a half (4½) and six (6) years can produce numbers up to twenty (20) and can further produce tenths up to hundred (100) (McEvoy 1989:197). Gelman & Gallistel (1978:210) see counting as a culturally transmitted formal system that enables one to make quantitative judgement exact.

Ginsburg and Russell (Starkey et al 1990:99) have reported a mean length of correct production of number word sequence of children from the affluent families and the poor families attending pre-school. Earlier than this observation, Wang, Resnick and Boozer (1971:14) found that 13 percent of kindergarden children from low socio-economic class did not successfully produce number-word sequence from one to five and that 32 percent could not produce a sequence up to 10. Their findings could partly be due to cultural differences and changes, and that they might have used other strategies including gaining the children's attention and interest which might have contributed to better performance (Starkey et al 1990:105).

The early and spontaneous development of counting has been observed not only in Western cultures or affluent environments but also in other cultures where children who have not been exposed to school environments have been tested in arithmetic tasks and the results are similar to those obtained with

young children in Western cultures (Starkey et al 1990:99 and Posner 1982:92).

Young children can demonstrate considerable ability in situations involving small numbers they are able to discriminate between visual arrays containing small numbers of elements (Starkey et al 1990:34).

Pointing plays an important role in children conception of counting (Brairs and Siegler 1984:611). They suggest a developmental progression in children's understanding of pointing. Children use a three-way one-to-one correspondence among, a word, an entity and a point. They point to the objects and verbalise the number word. Pointing may be a useful indicator of the act of linking number words and objects. Children as young as three are able to notice an error in their counting of objects such as double counts or skipping objects to be counted (Gelman and Meck 1983:352). However, children aged two have been observed not to point when counting objects, only later they spontaneously point to objects as they count them (Gelman et al 1978:221). It is only later that they come to discover that it is the derived word-entity correspondence that is crucial to the correct count.

2.8.2 Relation between ordinal numbers to cardinal numbers

As children grow older they get to understand that counting has an end product instead of just being a non-stop activity. It is when a child begins to link counting and cardinality. Cardinality is the ability to appreciate that the final count word indicates the number of objects or items in a set (Schaeffer et al 1974:360; Wynn 1990:156). According to Sophian (1987:52) young children are "triggered" to count when asked the question, "how many?". The

tendency is for the child to count the given objects or items and responds to the question "how many" by repeating the last number word. This in itself is an indicator that the child might be ready to be introduced to addition. Starkey and Gelman (McEvoy 1989:107) claim that young children aged three to five years were able to give simple addition and subtraction problems involving small numbers, by using their fingers. For as long as young children educators impress upon the child that counting is a means of qualification that is, the ability to appreciate that the next number in the counting sequence signifies more, a great improvement will be made toward producing young mathematicians.

2.8.3 Comparing

One feature that stands out clearly with number systems is the idea of order. Each numeral has a place in the overall number sequence. By comparing sets of objects, the child is in fact developing the order of numbers. The initial step is to compare sets of objects and later the child should be comparing numbers themselves (McEvoy 1989:101). Each number has a property, as such; there is no reason why the symbol five (5) is larger than the symbol two (2). It is only after the child has been exposed to the value of 5, through the use of concrete objects, and the value of 2, will be able to compare and sequence the numbers (Anselmo 1987:385). Comparison is essential to develop an understanding of order in the real-number system (Starkey et al 1990:105).

2.8.4 Seriation

The child can arrange objects in serial order or according to a particular characteristic or attribute such as mass - lightest to heaviest, temperature - cool to hot, length - shortest to tallest, and so on. The child later discovers that

quantity can be ordered. He somehow learns or sees and understands that one sweet more than one sweet, is two sweets, one more than four, sweet is five. The idea of adding one sweet to the number of sweets as indicated above is sure to lead him to understand that numbers can be listed according to particular order, such as one two three four five and so on.

According to Piaget (Pasnak, Cutcheion, Holt and Campbell 1991:7) the process of adding one number to another in thought is an action which is internalized in the sense that it could take place overtly, but actually takes place internally.

2.8.5 Number conservation

Number conservation is a notion that the number of a set remains the same or invariant even if the elements of the set are rearranged. To determine if the child can conserve number, the researcher could place a number of similar objects; let say marbles or beans about eight (8) of them on the table in a row. The child could be asked to make the second row in one-to-one arrangement. The number should not be less than eight (8), so that the idea of number remains on the child's mind. If the number is less the child is likely to use perceptual clues to respond to questions that might be asked by the researcher because he is strongly influenced by perceptual appearances (Krech et al 1982:296). If the child fails to arrange the objects to make a one-to-one correspondence, that is an indicator that he is not ready to conserve, because conservation is based on knowledge of equality, that is a one-to-one correspondence.

Another example of one-to-one correspondence was first looked into by Piaget (Frydman and Bryant 1988:324). He concentrated more on spatial tasks. He presented children with six bottles arranged in a row and the same number of glasses. Children are to build a row of glasses to correspond with the six bottles. What he observed was that children tended to match the two rows on the basis of length regardless of number. Later as they continue to work on the one-to-one correspondence they are able to match the rows in numbers, but become confused and misled by spatial transformation if one of the rows is spread out or squeezed. Whenever this happens they conclude that the rows do not have the same number of items any more. As they progress in age they become aware that change in the perceptual appearance of rows has no significant bearing on their actual number. Piaget reckons that this at stage is the only one which reflects an understanding of one-to-one correspondence. Piaget is seconded by Greeno (Starkey et al 1990:100) that one-to-one correspondence is a basic component of all existing counting procedures.

To find out and confirm that the child can conserve, questions such as, "Do the rows have the same number or are there more in one of the rows?" "Why do you think so?" If the child is able to conserve then he is likely to justify his response by giving a logic reason such as, "You did not take away or add any". Reversibility helps to lift the child from the realm of intuitive thought to that of concrete operations. When the child develops the level of reversibility, his thought become truly operational. According to Piaget (Copeland 1984:107) number conservation is usually attained around six to seven years of age.

The claim among the Piagetians that the concept of number conservation is attained around age six and seven years of age is seriously questioned by Gelman (Desforges and Desforges 1980:97). In her study she has observed that children as young as three years old have a general understanding of number conservation. That these children can conserve number provided the set is small and that progress in acquiring a more generated notion of number conservation arises out of practice in context of limited set size (Schaeffer et al 1974:376).

Resnick (1989:164) states that children as young as three years are conversant with the concepts, increase and less. These concepts are common in their daily lives. If they have a certain amount of something and they are given yet another amount of the same, they know that it is more and if nothing is added to the original amount they know that it remains the same, and if some quality of the original whole is taken away they know that the amount is less. This shows that children have the basic knowledge of number conservation well before they reach age 6½ years as proclaimed by Piagetians.

2.8.6 Classification

Much as counting is often the first mathematical idea introduced to children both at home and at school, the idea of number should grow out of a meaningful understanding of the inclusion relation that could be in the form of classification (Copeland 1984:60). In classification children are able to sort out or arrange objects according to their similarities while maintaining the identify of the subclasses (Anselmo 1987:11). The child discovers the attributes or characteristics of objects by observation and describing their similarities such

as sorting and matching according to colour, shape and so on (Pasnak 1987:359).

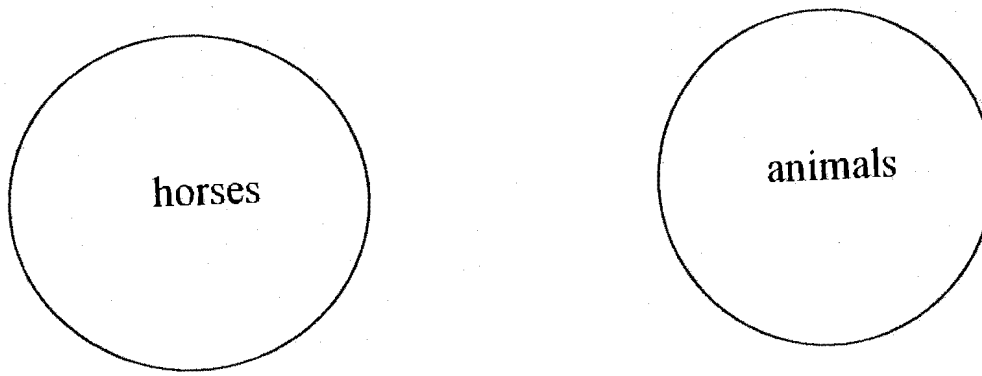
Classification serves as a basis for the development of both logical and mathematical concepts (Sovchik 1989:62). Simple classification is based on the idea of a relation. In a normal classroom, some of the first experiences for children are of a sorting type. Simple phrases such as "belong to" "belong in" "belong on" are used to sort out objects according to their relations. A school bag "belong on" the bag rail or shelve. The cap that Bontle is wearing, "belongs to" Mapule, "Belongs to" relates the cap to Mapule, because of this relation, the cap should be returned to Mapule. Pencils and erasers "belong in" the pencil container and so forth.

As children play and investigate objects, they realize that objects are related in many ways. Some are light others are heavy and some are larger than others. Some are related in colour, shape and size others float on water.

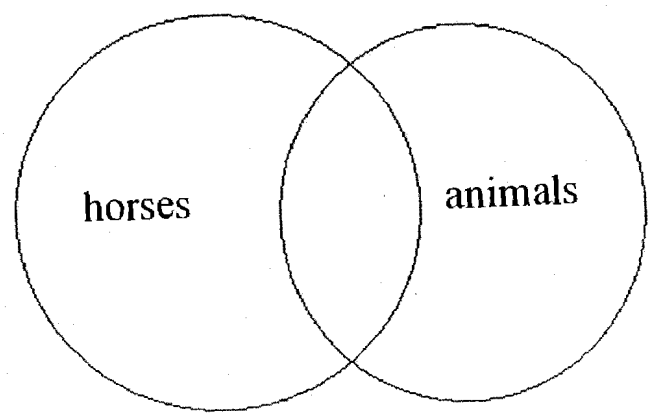
They even go the extend of classifying in terms of objects they like and objects they dislike. In performing such classification, children are learning about the world in which they live. Such classification is based on perceptual structures. As children grow older, the logic of class inclusion and hierarchical classification will require intellectual or logical structures. In perceptual structure, for example, a child will insist that a cat is a cat and not an animal, because he is unable to understand the logic of inclusion. No amount of verbal explanation or good visual aids, repetition or the like would convince him that a cat is an animal not until he passes that perceptual "state". This is confirmed and expressed by Piaget (Copeland 1984:62) that "A class cannot be

be constructed by perception, but only by logic, for it pre-supposes a series of abstractions and generalization from which it derives its meaning". (Copeland 1984:63) explains the logical classification very clearly by making an example to consider the relationship between "horses" and "animals". His argument is that in order to properly classify objects, one must be very clear about their relation to other objects already studied. Like in the case of say, horses. The question is, Are they animals? To verify the relationship as a basis of classification. Copeland used the Venn diagrams. Venn diagrams provide a convenient and powerful way of expressing the relation between the two or more sets as shown below:

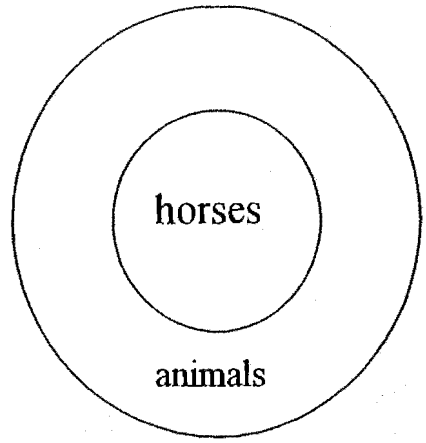
(a) If all horses are not animals, then the diagram reveals disjointed set.



(b) If some horses are animals and some are not, the diagram has intersecting sets.



(c) But if all horses are animals, then one set is included in the other.



In other words the third diagram expresses the relation correctly (Copeland 1984:63).

This example can be used in any form of inclusion relation like in the case of a fowl as against birds; an individual as against people, a shirt, skirt etc. as against clothes. Classification involves forming sets by determining the similarities and differences of objects and deciding whether to include an object in a given set. For example, a guinea fowl is a bird as well as being a guinea fowl, that it is. Why? Because it has wings and feathers, it has feet and it can fly. Classification involves apart-to-relationship often called class inclusion relationship (Sovchik 1989:61). Part-to-whole relations are conveyed by the quantifiers, "all", "some"; "none"; and "one" (Copeland 1984:66). Quantifiers such as "all" and "some" play a critical part in logical thinking and can in most cases be correctly used for classification by children when they attain nine to ten years of age (Copeland 1984:86). Copeland sights a test used by Piaget to determine the understanding of the words "all" and "some" by children. Piaget used a set of objects that included red squares, blue squares and blue circles, but no red circles.

The child was asked to identify the colours and shapes and was further asked "Are all the circles blue?" "Are all the blue ones circles?" A five year old child's response to the first question is likely to be "NO", Why? "Because there is a blue square" the child is unable to make a distinction between the two questions. Piaget (Copeland 1984:67) concludes that the child is unable to establish logical classes and his position would not change until he reaches nine to ten years of age. It is vital that the basic mathematics curriculum be designed to accommodate the child's developmental processes. Failure may lead to frustration, despair and discouragement for both teacher and the child.

2.9 BRUNER'S VIEW OF COGNITIVE DEVELOPMENT

Much as Piaget dominated the field of cognitive development, and stimulated a great deal of thinking among educators, there are other outstanding psychologists like Jerome Bruner and his associates. Bruner (Tomlinson 1981:202) postulates progression from inactive to iconic and then to the symbolic. The inactive stage corresponds to Piaget's sensory - motor stage where things are known only in terms of ones action on them. The iconic corresponds to Piaget's pre-operational stage whereby mental images of concrete objects are established and symbolic, in which the child uses the powerful flexibility of abstract symbol system in particular verbal language, corresponds to Piaget's concrete operations (Spodek 1985:113).

Bruner (Sovchic 1989:21) claims that humans first represent their experience of the world in inactive terms, that is by internalization of motor acts, in other words, inactive mode of representation is highly motoric and operates to some degree throughout our lives. Iconic mode of representation is prominent in children up to the age of six to seven years in most societies. Iconic

emphasizes the use of images such as pictures to explain experiences. For example the visual medium can offer precise knowledge of a concrete situation unlike the auditory medium. That emphasizes the need for teachers to fully attend to the total environment of the learner, to reach out to the learner and make learning meaningful. This can be achieved in a number of ways by teaching/learning aids/resources. Bruner's symbolic mode of representation depicts the use of words to represent objects and events. Symbols may represent abstract ideas including transformation rules and concepts (Krech et al 1982:300).

For example, if the learner can read and understand the following problem: "Pule had five marbles and gave two to his friend. How many marbles does Pule have now?" A learner who can read and write a number solution to an example like 5 - 2 = 3 is said to be at the symbolic level of knowing. Bruner (Sovchik 1989:21) views cognition as a means of interacting with the environment. He postulates that his stages are partly the result of interaction and adaptation with the environment. Bruner advocates a guided discovery process - orientated approach to concept development. This means that experimentation, meaning and intuition are emphasized so that children are guided to discover generalizations in classification activities and other mathematical concepts.

2.10 OTHER RECENT MODELS OF INTELLIGENCE

2.10.1 Sternberg's view of cognitive development

There are recent models of intelligence like that of Sternberg's information theory approach which features meta-cognition. Sternberg (1984:19) refers to meta-cognition as the learner's ability to selectively apply, monitor and

evaluate lower order components of cognition. The lower order components are those that govern some aspects of acquisition, retention, transfer or performance, communication, reading, attention and so on. Meta-cognition refers to a person's knowledge of his/her own cognition and the factors that influence thinking. In meta-cognition an individual has to be in touch with his mental abilities, he has to be aware of what goes on in his thinking faculty. That knowledge would afford him greater cognitive benefits than when he is blank or out of touch. Flavell (1977:78) defines metacognition as the observation and regulation of one's own cognitive processes.

Meta-cognition in young children is very limited to the extent that most children tend to over estimate their cognitive abilities. Studies of children's prediction performance by Stipek (1984:16); Sternberg (1985:64) have confirmed the fact that when most children are shown sets of items and asked to predict how many will they be able to recall, young children are in most cases, highly prone to over-estimate their actual recall abilities.

It could be claimed that there are benefits in the child's lack of awareness of his abilities. The benefits are two fold. In the first instance the child is inclined to practice that which he is unable to perform, that alone may lead him to effective use of these abilities in later life. It should not be forgotten that practice makes perfect. Secondly it helps the child to develop a more positive self-image than would be the case if he/she was aware of his/her limited abilities. This is confirmed by Bandura (Engler 1985:405) that self-efficacy evaluations play an important role in self-concept. Perceived self-efficacy influences the situations and experiences that one will attempt; whether or not one actually has the ability to perform these functions is not the main factor.

Meta-cognition is always regarded as a component of strategy training studies. A successful strategy training requires that an individual must have knowledge beyond the simple mechanics of its execution. The individual must understand how a particular strategy works and where when and why is it is used (Sternberg 1985:78).

2.10.2 Gardner's view of cognitive development

The other approach to cognitive development is postulated by Gardner (1983) with his definitions of at least seven different intelligence, that is, logical mathematical, linguist, visual spatial, bodily musical, interpersonal, intrapersonal and Kinetic. Gardner does not regard the seven intelligence as abilities that contribute to overall intelligence. He grants each one of them the full status as a separate kind of intelligence. His view is that cognitive competence can be domain - specific. He refers to intelligence as the ability to solve problems or create products that are valued within one's more cultural settings (Gardner 1983:127).

Gardner's theory of multiple intelligence emphasizes the view that the mind is organized in terms of relatively independent realms of functioning. For example logical mathematical intelligence stems from the child's confrontation with objects in his life world. He orders, arranges, classifies, conserves, calculates, and handles logical thinking. These actions progress from sensori motor skills to abstraction.

Linguistic Intelligence entails the ability to speak or write well and the ability to reason. It manifest itself in the choice of words sensitively and accurately. It is the ability to read with understanding (Faber and van Staden 1997:55). It

is the ability that is possessed by orators who can move the masses, the fiery preacher, the felicitous expressions of a poet. All these show the linguistic intelligence. Visual spatial intelligence, which makes it possible to form and manipulate representation of the world that is, the ability to paint, to take good photographs to make mobiles and so on (Heinich et al 1990:100). The next is bodily musical intelligence, that is the ability to compose songs, write poetry, sing, play instruments and appreciate melody and rhythm. Then there is the Kinetic intelligence which is consistent with dancing and athletics. It is optimized in sports achievers and great actors, the pianists, sharp-shooters and so on. The next is the interpersonal intelligence which refers to the ability to understand others (De Witt et al 1995:29). It could be referred to as social intelligence like the ability to read others hidden agendas. Finally what follows is the intrapersonal intelligence centres around the understanding of self that is the ability to access own inner feelings (Engler 1985:281).

(Gardner 1983:158) accepts that most people regard the seven facets as traits or talents rather than different intelligence. He argues : "If critics were willing to label language, and logical thinking as talents, as well as to remove these from the pedestal they currently occupy then I would be happy to speak of multiple talents. But I strongly resist any attempt to use a contrast between intelligence and talent as a veiled attempt to ignore or minimize the range of critical human abilities" (Gardner 1983:162).

2.10.3 Feuerstein's approach to cognitive development

Several approaches have been introduced on the question of "zone of potential development" (Tomlinson 1981) of children by adding problem solving cues at failing points in the problem solving tasks given to children.

The relevant assistance given by a teacher or adult in the process of problem solving provides evidence of potential development level that the child is to reach. According to Sternberg, (1984:34) this fact is confirmed by Gudoff, Corman and Litzinger (1974) in the USA; Flammer (1974) in Switzerland; Feuerstein (1971) in Israel and Guthke (1976) in Germany. Sharron (1987:37) also confirms that children require the guidance and help of another human being for the quantum leap into higher mental abilities, like logical thought. Psychological instruments to measure change or potential differ in many respects. However the one that has gained more ground is the Learning Potential Assessment Device (LPAD) presented by Feuerstein, (1979) and the compendium work, Instrument Enrichment (IE), also by Feuerstein (1980).

Feuerstein believes that child who is mentally challenged can still be helped to be normal. In his Leaning Potential Assessment Device (LPAD) He talks about taking children "beyond themselves" (Goldberg 1991:37). To him, children who are mentally challenged and are unable to operate on the same level like normal children, can still be modified to move into the normal culture. All they need is an adult intervener, mediator, a motivator, they need an adult who can "walk with them and can lead them to the world of normality". Mediated learning is about helping the child to learn how to learn and to learn how to think (Haywood 1997:9).

Feuerstein like Vygotsky (Fielding 1989:32) was confronted by an influx of children traumatized and orphaned by the holocaust. These children's mental abilities were usually very low.

According to Vygotsky (Fielding 1989:47) at any stage or point in the development of cognitive skills of a higher order, though not fully developed, these additional skills can be triggered off by an adult or peer mediation or intervention. Intervention awakens or arouses to life those functions which are in a stage of maturing, which lie in a zone of proximal development (Fielding 1989:46).

Feuerstein believes that the higher forms of human cognitive development are the results of learning which is mediated by human intervention. Vygotsky as well as Feuerstein (Haywood 1997:10) agreed on two most important points that: "The learning of higher order cognitive processes and conceptual information requires the mediation of a teacher and that instructional content should embrace those cognitive skills and concepts which extend beyond the child's present capabilities and repertoire".

According to Sternberg (1984:10) Feuerstein, when confronted with a child whose IQ is in the 60's for example, a child labelled autistic, the basic question that comes to his mind centres around how this child can be helped to go beyond himself". Feuerstein and his colleagues, believe that one successful teaching method, so far to be recognised is in what has become known as mediational teaching style.

The child who is highly challenged needs an adult intervener who will offer him a purposeful direction. Feuerstein believes that it is not enough to provide a child with books, music and other resource for learning, he expects an adult to help the child to interpret and make sense of the materials so that the child could move from the situation in which he was to "beyond himself" (Sternberg,

1994:12). Feuerstein (Goldberg 1991:37) believes that human beings can be changed if the intervener is engaged emotionally. One would feel compelled to help, especially if one believes that change is possible and the need for change is urgent. Having worked with troubled youngsters who were challenged emotionally and mentally as well as those who were severely culturally deprived. Feuerstein's aim has always been to mediate and help these children to come out of the terrible condition, to integrate with the community, to develop and mature and become able to function like normal people. Feuerstein, together with Rand and Hoffman (Frisby and Braden 1992:292) came up with an instrument to measure change known as Learning Potential Assessment Device (LPAD). The LPAD represents a deviation from the conventional psychometric assessment model. It is considered to be dynamic rather than static that is, it assesses the capability of being changed through learning rather than just what has been learned. The LPAD will not be discussed in this study because it forms a study on its own.

It is, however necessary to touch on Feuerstein's (1980) Instrumental Enrichment (IE) to know what it entails. The programme was designed for use with mentally challenged children. It has since been recognised by the originator and other psychologists to be valuable for children at all levels of intellectual spectrum, IE is intended to improve cognitive functioning related to the input, elaboration and output of information. Feuerstein compiled a list of cognitive deficiencies his programme is intended to correct. The list includes among others:

(a) Lack of capacity or impaired capacity for considering two sources of information at once, reflected in dealing with data in a piecemeal fashion rather than as a unit of organized facts

(b) Inadequacy in experiencing the extent of an actual problem and subsequently in defining it

(c) Lack of strategies or impaired strategies for hypothesis testing

(d) Lack of orientation toward the need for logical evidence

(e) Lack of planning behaviour or impaired planning behaviour

Lack of holistic grasp of reality. The individual is unable to relate different aspects of his or her experience to one another. Feuerstein seeks to correct these deficits and at the same time, to increase the student's intrinsic motivation and feeling of personal competence and self-worth (Sternberg 1984:38-47).

According to Sternberg (1984:41) the Instrumental Enrichment (IE) programme consist of several different types of exercises which are repeated in cycles throughout the programme. (The exercises will just be mentioned without elaboration). They include among others:

(a) Comparisons
(b) Orientation of dots
(c) Categorization
(d) Temporal relations
(e) Numerical progressions
(f) Instructions
(g) Representational stencil design
(h) Transitive relations

The IE programme raises the children's intrinsic motivation and self-esteem. It has been proven to raise children scores and ability (Brown et al 1983:61). Most of the training exercise are similar or identical to those found on intelligence and multiple aptitude tests. It should be surprising that intensive practice and training on such items should raise high tests scores. IE requires

intensive practice and training before talking facilitations. Training has to be administered by a designated training authority for the duration of the period (Sternberg 1984:34).

The IE approach does not seem to emphasize the transferability of the skills to academic and real world intellectual tasks, such as reading, mathematics and so on, especially over the long term.

Feuerstein's IE did not escape the criticism by Frisby et al (1992:281). They argue that the proponents of Feuerstein regard retarded performers as persons who possess unlimited learning potential whose condition can be modified so that they can join the main stream. They both claim that Feuerstein and his colleagues run the risk of adopting the logical tautology of old time faith healers, failure to be healed implies deficiencies in the individual's degree of faith (Frisby & Braden 1992:294).

2.10.4 Carl Haywood's approach to cognitive development

Carl Haywood (1997:7) strongly feels that the major goal of education is to develop processes of logical thought that can be applied to the solution of personal, social, moral problems and their dilemmas. People should be taught what to think but rather their minds must be geared to learning how to think effectively and systematically.

Carl Haywood, is of the opinion that most education system have failed to adjust the goals and philosophies of education to be in line with modern challenge. He claims that the school curricula are still being offered that look "like those of 100 years ago (Classic academic content) or that are watered-

down as to offer real learning to anybody" (Haywood 1997:6). His concerns are confirmed by O'Sullivan (Haywood 1997:8) who claims that curriculum is driven, by outdated models of learning and that little attention is paid to the development of cognitive processes and how to modify it.

It is interesting to state here that in South Africa, a lot of work has been directed toward the school curriculum innovation/development to be in line with what entails in other advanced countries. Emphasis is placed on outcomes based education (OBE) in this approach, the teacher's/educator's role is to facilitate by setting the stage for the learner and to mediate whenever need arises.

Haywood (1997:3) feels that philosophies have to shift from information-giving to enhancing educatibility : teachers should change from being givers of information to mediators of expertise, facilitators, guiders of students and their parents, there should be recognition of the teacher's role in motivating cognitive growth, students have to be equipped and encouraged to learn on their own, and to learn how to learn.

According to Haywood (1997:3) some of the most promising and innovative programmes ever to be offered in education have had, on the whole limited success. For any programme to register success, it must be totally accepted by administrators on the field of education. Well trained teachers must implement it; it must be confined to a small portion of the school but should run across the whole school. It must have a well-designed mode of assessment.

2.11 CONCLUSION

In this chapter the researcher has tried to illuminate the capabilities of young children in mathematics based on the contributions of the developmental psychologists such as Jean Piaget and Jerome Bruner who believes that mental processes of the child must be taken into consideration and the child cannot learn the same content as an adult, and that there are developmental stages in the ability of the child to think logically or mathematically. The child has to reach a certain point of development before he is "ready" or able to understand mathematical concepts as illustrated in the chapter. However this line of thought will not be left unchallenged by the behaviourists who are less concerned with readiness" to them the child misses no necessary step and consequently should not fail if the programme has been tailored correctly. The assumption is that the child can be taught or exposed to logical processes at any stage of development.

The thinking of other recent developmental psychologists have also been dealt with. Sternberg's theory of meta-cognition whereby an individual has to be in touch or know his mental abilities and the factors that influence his thinking Sternberg (1985:78). Gardner's theory of multiple intelligence which emphasises that the view that the mind is organized in terms of relatively independent realms of functioning. He postulates that a person has at least seven different intelligence i.e. logical mathematical intelligence, linguistic intelligence, visual spatial intelligence, bodily musical intelligence, Kineasthetic intelligence intrapersonal intelligence and interpersonal intelligence (Gardner 1983:160).

In his approach to cognitive development Feuerstein believes that it is not enough to provide learning material to the child, the child needs a mediator, an intervener and motivator who can help him make sense of the learning material. He believes that a learner can be changed or learning can be effective if the intervener is engaged emotionally as well, so that the learner could move from the situation in which he was to "beyond himself" (Sternberg 1984:12).

Carl Haywood (1997:7) postulates that learners should not be taught what to think but rather, their minds must be geared to learning how to think effectively and systematically. Haywood is of the opinion that emphasis should be placed on child or learner centred approach.

This chapter will be followed by chapter three which will look into the various instructional media available in most schools and particularly instructional media for teaching mathematics in the early years.

CHAPTER THREE

3. INSTRUCTIONAL MEDIA AVAILABLE IN SCHOOLS

3.1 INTRODUCTION

This chapter draws on the various methods that can be used in conjunction with media. Various instructional media described in this chapter cover a wide range of types suitable for learners of all ages. The latter part of the chapter specifically covers most material used for young learners. These too, often incorporate various visual and audio types of media.

3.2 INSTRUCTIONAL MEDIA

Media are carriers of information from a source to a receiver (Clark 1994:7). Such carriers are known as instructional media when they are used to convey messages intended to change behaviour. Educators have at their disposal a very large variety of media that can be used to achieve their lessons objectives. Media is divided into three categories namely visual, auditive and audio-visual aids. Visual media are carriers of images, auditive media are carriers of sound and audio-visual media are carriers of sound and images. These categories are further divided into the following : Under visuals we have projecting and no-projecting media. Under projecting media are overhead projectors, slides, filmstrips, silent motion pictures, opaque materials etc. Under non-projecting media are models, fieldstrips, realia, illustrations, charts and diagrams, flannel boards, maps, posters, photographs etc.

Under auditive media are compact discs, tapes, radio, telephone etc. Under audio-visual media are non-projected media such as field and study trips, concerts, demonstrations etc. Projected audio-visual media are, sound films,

television, printed material with recorded sound etc. Media can only be effective if it is accompanied by relevant methods of instruction (Kozma 1994:5). Instructional methods have been described as presentation forms. They are instructional procedures that are identified to enable learners to achieve the desired outcomes. They help to internalize the content that has to be learned. The following are some of the methods applicable to learners of all ages: presentation form, demonstration, drill and practice, tutorial, gaming, simulation, discovery and problem solving.

3.2.1 Presentation method

In the presentation method of instruction the source may be an educator, a text book, and audio tape, a film and so forth. The source tells, dramatizes or disseminates information to learners. There is no interaction or immediate response expected from the learner. It is a one-way communication controlled by the source. Reading a book, listening to a tape recorder, viewing a film are good examples of presentation method (Mbambisa, Engelbrecht and Lubbe 1990:25). Objections that are sometimes raised against presentation method which is sometimes known as narrative method focus mainly on the following: that it causes the learner to listen passively, that more talking is done by the educator and he/she dominates the learning activities and it encourages memorization rather than understanding (Kruger, Oberholzer, Van Schalkwyk and Whittle 1983:102).

3.2.2 Demonstration method

In the demonstration method of instruction, the learner views a real life-like example of the skill or procedure to be learned. Demonstration may be recorded and played back by means of media such as video or film. This could

be made more effective if the learner practices what he sees under the supervision of the facilitator (Kruger et al 1983:104). This method can also be effective in introducing ordering to young children. For example, the teacher can arrange a set of objects in a row (demonstration) the learner could be asked to make a row "like mine". Children between 2 and 3 are unable to make a copy of the row. As they grow older, and after some demonstrations by the teacher they get to understand the notion of order and make a copy of a row by constantly checking his/her row against the model, other mathematical concepts relating to number conservation can be demonstrated to learners. Demonstration ensures that the learners are not passive observers. All they need is an educator who can give them immediate feedback while observing their performance (Rowntree 1990:240). According to Van der Stoep in (Kruger et al 1983:104) the educator can better explain certain concept by means of demonstration than by any other method and the demonstration varies from one situation to another. He further states that demonstration does not necessarily consist of mere performance of exemplary acts for the learner. It is aimed at the formation of a mental image.

3.2.3 Drill and Practice method

In drill and practice method, first of all the learner has to receive instruction on the concept to be learned, the principle or the procedure that has to be practised (Kruger et al 1983:112). Drill and practice exercises are designed to increase fluency of a new skill or to refresh an existing one (Mbambisa et al 1990:). Drill and practice is commonly used in intensifying mathematical concepts. Certain media formats and delivery systems lend themselves particularly well to learners drill and practice exercise. In the case of young learners this method can be effective when the learner works on puzzles,

building blocks, logos, and lottos. They do not tire from repeating, which is, in actual fact practice of the process.

3.2.4 Tutorial method

In tutoring, the method entails a one-to-one approach It is often used to teach basic skills such as reading and mathematics. The educator poses a question or problem and requests a learner to respond. Practice is provided until the learner demonstrates a predetermined level of competency. Tutorial arrangements include educator-to-learner, learner-to-learner, computer-to-learner and print-to-learner (Heinich et al 1990:8).

3.2.5 Gaming method

Gaming can provide the learners attractive and stimulating effective frameworks for learning activities (Rowntree 1974:106). Some instructional games add motivation to topics that attract young learners interests (Heinich et al 1990:334) such as visual perception, number concepts, sequencing etc. The instructional game is an activity structured with set rules for play. It is aimed at reading set objectives. This method is suitable for young learners. Simple activities such as sorting and classification can be taught through this method. Gaming provides a playful environment in which the learners follow rules as they strive to attain a challenging goal (Gerlach and Ely 1971:340). For example, in an activity of additive classification, the learner's ability is explored by placing objects in categories based on the likeness or differences of the objects. In this activity, triangles, squares and circles, in two sizes and each size in two colours. The shapes may be made of wood or cardboard.

The objects are mixed on a table before the learner and he is asked to arrange groups so that the contents of each group is alike in some way. If the learner can group by one criterion, such as shape, then the objects are mixed again so that he can group them in another way, probably by colour or size. Learners could engage in this process in a playful manner. Games will extend the opportunities for learning because of the sensory properties of the props used and a great deal of human interaction (Spencer 1996:128). Material to be used in games should be identifiable as being real or just a picture or model. For gaming to be effective the educator must define learning objectives, and what the learners will do after having played the game that they could not do before. For how long are learners to be occupied in this game the educator must select the resources to be used. The educator should develop post game evaluation (Brown et al 1977:301) and they can continue to play this game on their own, and at the same time an achievement of goal is reached. Material for classification is abundant at home and in the classroom. Working with concrete shapes and sizes and colours and discussing all sorts of relationships will expose the learner to understanding our environment by naming and relating things.

3.2.6 Simulation method

This method may involve manipulation of materials and equipment (Heinich et al 1990:10). In mathematics the learner manipulates mathematical models to determine the effects of changing certain variables. For example in real life simulation device (Brown et al 1977:301) the learners could be introduced to the use of a beam balance for conservation of weight. Learners can be led to weigh material on a scaled down beam balance, it could be homemade or commercial. The learner when manipulating the beam balance, after several

practices and educator's intervention, he/she realizes that there is an inverse relation between weight and distance, that the smaller the weight, the further it must be from the centre to balance a heavier weight (Copeland 1984:45). The educator's responsibility in simulation or gaming is to assess the readiness of learners to participate in and succeed with any activity selected.

Simulation as in gaming also has instructional objectives (Brown et al 1977:292). In simulation there is no winner. Learners participate under safe and controlled situation The results of simulation are observable changed condition (Brown et al 1977:292) or situations to be achieved by the learners.

3.2.7 Discovery method

In the discovery method, the learner is presented with a problem that could be solved by trial and error. The method uses inductive or an inquiry approach to learning. The aim is to foster deeper understanding of the content through involvement with it. Instructional media can help promote discovery or inquiry. For example, by viewing a balloon being weighted before and after being filled with air, the learner discovers that air has weight. This method is used by the educator to present learners with opportunities to make certain discoveries of arriving at certain conclusions or inventions on his own. The educator can set-up self-activity learning processes for his/her learners. Self activity is the basic principle in teaching and learning and it is more pronounced in the form of assignments for older learners and in play for young learners (Kruger et al. 1983:107).

3.3 VISUAL DESIGN

Most people are visually oriented. As early as infancy, human beings

associate themselves with most of what they see in their environment (De Witt et al 1995:52). That association leads to learning to know and understand their life world. According to (Heinich et al 1990:68) most people learn about ten percent from listening, over eighty percent from what they see.

They remember about twenty percent of what they hear but over fifty percent of what they see and hear.

People are surrounded by visual messages almost everywhere they go. The amount of learning that occurs through visual messages and stimulation (Roelofse 1987:219) especially in the classroom learning situation necessitates the proper knowledge, design and effective use of visuals in instruction.

3.3.1 Visuals as referents to meaning

Visuals normally resemble the object they represent. They serve as concrete clues to meaning. When an object being discussed is not available, the next best referent is a visual representation of it. It can be concluded that effective communication is always best served by the use of the most realistic visuals available (Spencer 1996:134). Spencer in support of the effectiveness of visuals states that: "The usually difficult material is more effectively received with a visual presentation whereas, particularly easy material is better understood with an auditory presentation. The relative effectiveness of the visual presentation increases with increasing difficulty of the material".

Joy and John Menne (Spencer 1996:79) tested their subjects under aural, visual and audio-visual presentations. The results demonstrated that an audio-visual presentation was superior to either presentation alone.

3.3.2 Pictorial representation

There is a distinction between pictures people prefer to look at, and appreciate and those from which they learn the most. According to Dwyer (1987:256) children in primary school prefer colour to black and white pictures and that younger children prefer simple illustrations over complex illustrations that are preferred by older children (Spencer 1996:46).

For learners to benefit from visuals, they need to be able to translate or 'read' visuals accurately (Brown et al 1977:173). They need to understand and be guided towards decoding or translating the visuals into verbal messages. They need to be helped to develop the skill of using visuals to express themselves like in the case of drawing Translating visuals into verbal message is referred to as decoding and expressing oneself through visuals is referred to as encoding.

Younger learners have difficulty in decoding visuals holistically. They interpret parts of a whole and single out specific elements that capture their attention. As a result, seeing visuals does not automatically ensure learning from it. The educator must always guide the learners for effective learning to take place.

There are factors that might contribute to failure of learners to decode visuals such as learner's cultural background and colour preference (Spencer 1996:45). Cultural background has a very strong influence on learning

experience. For example, if instruction includes visuals that do not depict what is in the learners cultural background or unfamiliar scenes that have no bearing on the learners first hand knowledge may end up in confusion (Heinich et al 1990:68).

Colour preference may also be culturally biased. The symbolic values given to various colours are not universal. For example purple and white colours are used in some Eastern countries as the colours of mourning. In Western countries, black is generally accepted as the colour of mourning. Colour does not only enhance and enrich visual designs but also has influence in the person's mood. Colour commands attention and gives visual impact. Some colours are perceived to be 'cool' as in the case of blue, green and violet. 'Hot' in the case of red, orange and pink. The educator can take advantage of colour to help the learner to recall material or content presented (Faber et al 1997:65).

3.3.3 Designing visuals

Wall sheets, such as pictures, charts, diagrams, posters bulletin-board display not only promote learning but also provide aesthetic models for learners' own creative development (Kruger et al 1983:273). It is always right for learners to 'see' and 'understand'. Learners always understand concepts when they have visualised or have seen Botha (De Witt et al 1995:55). It can be concluded that the most effective teaching aids are those which contribute a visual impression.

Charts and pictures serve different purposes. Pictures help to illustrate and bring a sense of reality to what is taught (Brown et al 1977:182) like in story

sequencing cards, whereby clues to proper sequence are given in the pictures and text on each card, predicting outcomes (Faber et al 1997:65). Pictures stimulate interest and create correct impression and bring lessons to life (Spencer 1996:136). Charts on the other hand are more useful as a means of presenting the material that has to be learned in a memorable form.

3.3.4 Factors to consider when creating visuals

When creating visuals, it is important to start with a preliminary sketch of the intended visual (Heinich et al 1990:76). Choose the right words, correct lettering, right colours and to make sure that the visual conform to the principle of unity, line, shape, form, arrangement, balance and interaction (Brown et al 1977:100).

3.3.4.1 Unity and harmony in creating visuals:

It is always wise not to crowd information into one space. It is good to eliminate elements that are not essential to what is being communicated (Heinich et al 1990:77). Only visual material that emphasize the point should be used and it must be arranged in such a manner that it helps to answer the objectives set out for the lesson (Brown et al 1977:95).

3.3.4.2 Form in creating visuals:

Much as most visuals are two dimensional with lines and shapes an addition of form can bring about a third dimension, to create a feeling, in the view as in the case of collage whereby texture is used to emphasize a visual image of the sense of touch (Faber et al 1997:17). Material such as wool can be used to represent clouds. Grains such as rice, maze, rye and so forth can be used to represent the surface of an object or drawing.

The layout of visual material should capture the learner's attention and draw him to the important and most critical information built-in into the visual (Spencer 1996:136). Crowding material in one corner does not create stability of the visual form (Heinich et al 1990:87).

Visuals should be designed in such a manner that they can be manipulated to provide for learner interaction with the said visual as in the case of puzzles, answer cards, movable lettering and many more.

3.4 NON-PROJECTED VISUALS

Non-projected visuals are in the form of pegboards, bulletin board, displays, chalkboard, magnetic boards, flip charts, flannel boards, multipurpose boards, posters, drawings, still pictures, models, and so on (Mbambisa, Engelbrecht and Lubbe 1990:91).

Non-projected visuals are valuable because they do not need electricity or source of light (Mbambisa et al 1990:91). They can easily be made by the teacher and are available in a large variety of sizes, colours and shape and are not very expensive. Their use can be varied to suit different circumstances. A brief description of some of the non-projected visuals available in most schools are:

3.4.1 Models

A model is a three dimensional representation of a real thing. It can be the same size of larger, or even smaller than the real thing. Learners should be informed of the actual size of the model in order to avoid misconceptions (Mbambisa et al 1990:94; Faber et al 1997:65). A model can represent a living

or a non-living thing. Models can be handled and manipulated. Some of the most common three dimensional models or teaching/learning aids are relief maps, globes, dioramas and others. Since the learners are normally encouraged to handle and manipulate models especially those models which can be assembled and disassembled to provide interior views, it is a good idea to store them out of sight when not being use for instruction to avoid learners attention being drifted away from other learning activities. The learners derive interest in solving problems in which they actively and intimately involved (Gerlach and Ely 1971:341).

3.4.2 Field trips

Field trips are excursions outside the classroom to study, observe, experience real processes, people and objects. Field trips make it possible to reach out to things, living and non-living, that cannot be brought to the classroom (Rowntree 1974:109). Popular field trips include zoo's, museums, park, public buildings and public places. For the young learners it can be a trip a few minutes into the school yard to observe plants, insects and trees. Field trips are particularly valuable for young learners. They particularly learn better and more. Teaching during excursion is a welcome change from classroom routine. Teaching can then be informal and learners are inclined to participate. Excursion encourages incidental learning. Now a days most places of interest have trained personnel who are capable of teaching learners on site. Learners can benefit from the guidance of these people. Field trips need to be well organised to provide follow-up activities which are backed-up by factual information gathered during the trip. The evaluation of the trip is equally important to cover content and possible ways to improve future educational trips (Brown et al 1977:43).

A field trip should grow out of regular course study or in the case of young learners, it should provide enrichment for factual information communicated to them. It should be planned in such a manner that the learners get first-hand experiences with places, situations and objects that cannot be provided in the classroom. The learner's awareness of his/her environment will be sharpened. Field trips improve attitudes and make the learner's world to be more meaningful to him/her.

3.4.3 Realia

Realia are real things (Brown et al 1977:270). They are objects such as cutlery, tools, coins, animals and many others that can attract the learners when used as educational media. In the case of young learners, objects such as specimens of actual plants, animals, or part thereof preserved for convenient inspection, can be brought to the school. The child learns from realia at school when realia is systematically organised or deployed (Rowntree 1974:106). Textures and sound, the smell and taste of food all build up to what Gagne (Spencer 1996:129) calls signal learning and stimulus - response learning from the moment of birth. As the child grows up and is exposed to a wide range of realia, variety of toys, pets, adults in his life, all that comprises his immediate environment. Educators need not forget that preliminary experience with realia forms a basis for symbolic experiences (Nunan and Lamb 1996:199). Beside being used as means of presenting information, raising questions and allowing the learners to gain hands-on learning experience, realia can be displayed in a central location where learners can identify them, classify them according to their qualities, sorting them accordingly and generally interacting with them by comparing and contrasting them with concrete material.

3.4.4 Illustrations

Illustrations are in general more finished and representational than sketches. They have details, illustrations are readily found in textbooks and other learning materials. They are said to form a very important part of the pictorial representation mode (Ripley 1992:28). Most educators belief that illustrations must add to recall comprehension and understanding (Spencer 1996:82). Samuels (1970:405) is of the opinion that even though research in general does not show that pictures aid comprehension, neither does it show that they hinder comprehension. Levie and Lentz (1982:198) research on the effect of visual illustration on the learning of verbal information presented on the text as against non-illustrated text information. The results were statistically significant and in favour of illustrated text (Levie et al 1982:230). Practically every lesson presentation might benefit from the use of illustrations (Rowntree 1990:152).

3.4.5 Charts and diagrams

Charts are graphic representations of abstract relationships such as quantities, hierarchies etc (Heinich et al 1990:109). There are flow-charts, tabular charts, classification charts, flipcharts, and organograms as well as charts that are used for instructional purposes. If charts are used for young learners they should have a clear well defined purpose. It should be attractive. A chart used as medium of instruction for young learners, should express one major concept. A chart should not be cluttered otherwise it tends to be confusing (Heinich et al 1990:77).

Charts and diagrams can be divided into two categories. The first category include those that are used to illustrate lessons. They complement teaching and can only have value if they are used by the teacher in presentation (Brown

et al 1977:110). They include flash cards, pictures graphs and reverse cards. The second category are those that are used at exhibitions. Charts used at exhibitions if left on the wall or display boards for too long they deteriorate to mere decorations or wall papers. Otherwise if properly used they attract attention, stimulate interest and offer challenge to investigate more about the information. Charts used for young learners should be clearly drawn, coloured and large. All learners should be able to see the diagram which should contain only what is necessary for achieving the objectives of the lesson (Yule and Steyn 1986:24).

3.4.6 Chalkboard

The chalkboard remains an important tool to teaching. It is cheap and is readily available. It can be cleaned and re-used repeatedly. No electricity is required besides a box of chalk. Using chalkboard requires practice as well as planning. The main ideas can be written on it for all pupils to see. Explanations of difficult concepts can be done by means of sketches or diagrams on the chalkboard. The educator must make sure that what he/she writes on the chalkboard should be correctly spelt and that sketches should be accurate. The chalkboard is a medium for teaching and learning (Yule et al 1986:14).

3.4.7 Flannel Boards

Flannel board is a board covered with flannel material or felt. Any item such as numerals, letters, words, maps, pictures and symbols, provided they are light in weight can be exhibited on this board (Mbambisa et al 1990:92). The items can cling on the board if sandpaper is pasted on the back. It is valuable in teaching young learners stories and numerals. The items can be

sequentially as the presentation is in progress. It affords the learners the opportunity to handle and manipulate the material. The other advantage of using a flannel board is that the items can be used to illustrate the effect of movement of figures and shapes to different positions. The items can be taken apart and reassembled for the purpose of revision and explanation (Powell 1981:25).

3.4.8 Multipurpose Board

These are modern boards used in the place of normal chalkboards. They can be used for more than one purpose. They have smooth white plastic surface. Marking pens rather than chalk are used for writing on these boards and can be cleaned with a damp cloth or special felt eraser. Because they have a steel backing, they can be used as magnetic boards (Brown et al 1977:90).

3.4.9 Graphs

Graphs are visual representation of numeral data. They portray the relationships between units of data and trends in the data (Heinich et al 1990:108). Graphs can be used to interpret data and can easily be understood than when data is in tabular form.

3.4.10 Cartoons

Cartoons are rough caricatures of real people, animals and events. They appear mostly in a variety of media. Young learners find them very interesting. They also appeal to adults as well. However if used as learning aids they should be within the experience and level of cognitive development of the learner.

3.5 PROJECTED VISUALS

Projected visuals refer to media formats in which still images are enlarged and displayed on the screen (Mbambisa et al 1990:95). The following are some of the projected visuals: overhead projector, slides and filmstrip projector and opaque projector.

The following is a brief description of some of the projected visuals available in some schools.

3.5.1 Overhead projector

A typical overhead projector is basically a box with a glass plate at the top. Inside the box there is a light from a powerful lamp. The light is condensed by a special type of lens known as fresnel lens. The light passes through a transparency placed on the glass plate. A transparency is about the size of an A4 sheet of paper. Above the box is a lens and mirror system mounted on a bracket. When the projector is turned on it sends a 90 degree light beam that projects the image back over the shoulder of the presenter. Transparencies may be used individually or in series of images. The advantages of using an overhead projector are "immerse". Its bright lamp and efficient optical system generate very powerful light on the screen that it can be used in normal classroom lighting. The overhead projector is lightweight and can be easily moved from place to place and it is easy to operate. A variety of material can be projected, these include small opaque objects, picture cutouts and cutout silhouettes and a variety of transparencies. Projected materials can be manipulated by the teacher or presenter. Important items can be highlighted with coloured pen. Transparencies can be prepared in advance and overhead

projected visuals can teach the learners to recognise unfamiliar objects (Anderson 1976:48).

The overhead projector has some limitations, (Gerlach and Ely 1971:359) it cannot be programmed to display visual sequence by itself. Presentation is highly dependent on the teacher or presenter. An overhead projector is not a suitable teaching aid for young learners.

To get the best out of an overhead projector, the teacher/presenter should shift the class/audience's attention back to him/her by switching off the projector during changes of transparencies and also when the particular point being presented has been completed (Anderson 1976:48). The presenter can reveal information line by line by masking other portions for later presentation.

3.5.2 Slides

Slides refer to small format photographic transparencies 5 by 5 centimetres individually mounted for one at a time projection. The type of image vary with the type of film. They are among the most useful versatile educational aid or media. They are relatively cheap to produce and adapt. The advantage of using slides as a medium of instruction is that they an be manipulated by the presenter. They can be arranged and rearranged into many different sequences. Automatic projectors hold slides in trays and they are fed into place in sequence. Slides can be integrated into individualized instruction programmes. Normally slides are used as a large group medium, however they are now available for small groups and independent study. Slides can be used as medium of instruction and learning by both learners, young and old. The limitation of using slides is that it generally requires lighting to be dimmed

for effective projection. This concern presents a problem in most cases, when a slide is used as an instructional aid (Anderson 1976:57).

3.5.3 Filmstrip

A filmstrip is a roll of 35mm transparent film containing a series of related still pictures intended for showing one at a time (Heinich et al 1990:150). The filmstrip is normally in sequential order as such it can often be a good teaching and learning aid. A filmstrip can show action at slow motion or accelerated speed (Mbambisa et al 1990:96). Some filmstrips are silent others are accompanied by recorded sound tracks. The pace of viewing filmstrips can be controlled by the teacher or user. Filmstrips can be used by an individual learner for independent study and by a small group (Brown et al 1977:190). Filmstrips allows learners to identify or discriminate what has to be learned (Heinich et al 1990:151). The limitations of using a filmstrip is that the frames are permanently fixed in a certain sequence, making it impossible for re-arrangement of pictures without destroying the filmstrip (Wyman 1976:107).

3.6 AUDIO MEDIA

Audio media are the various means of recording and transmitting a person's voice and other sounds for instructional purposes. The effectiveness of audio media is dependent on hearing and listening. The two are necessary processes, as they pertain to communication of ideas and information.

3.6.1 Developing listening skills

Listening like any other skill can be improved with practice. There are a number of techniques that an educator can use to improve learner's listening abilities like in the case of directed listening, before oral presentation of a

lesson, the educator must lead the learners on with questions to guide their listening. One of the techniques is, following directions, here, the learners are given direction individually or as a group on the audiotape and are directed to follow these instructions (Faber et al 1997:57). The educator should interact with the learners. The learners must be encouraged to look out for main ideas, details and inferences. It is important that the educator must take the learner's age and level of development into consideration. Another technique for developing listening skill in using context in listening (Brown et al 1977:204; Nunan et al 1996:188). For young listeners close procedure could be applied. They can distinguish meanings in an auditory context by listening to say, sentences with words missing and then supply the appropriate words. Learners should be exposed to analysing the structure of a presentation. After listening to the audiotape, the learners, together with the educator could analyse the presentation (Faber et al 1997:57). The main objective is for the educator to assess whether the learners understood the content. Finally the learners should be able to distinguish between relevant and irrelevant information. After listening to an oral presentation of information, learners could be asked to identify the main ideas. This exercise is only possible with older learners.

3.6.2 Characteristics of audio media

The advantages of using audio media is that they tend to be inexpensive form of instruction. In the case of audio tape, once the tape and equipment have been purchased, there is no additional cost because the tape can be erased and be re-used to record a new message. They are readily available and easy to use. For young learners who cannot read audio media can provide early language experiences (Heinich et al 1990:162). With a little imagination on the

part of the educator, audio can be very versatile, and can be used to present stimulating verbal messages more dramatically than printed information. Audio cassette recorders are portable and can be used in or outside the learning site. However, as with all media, audio instructional devices have limitations, they tend to fix the sequence of a presentation even though there is a rewind mechanism. Development of audio materials by the instructor is time consuming.

3.6.3 Types of audio media

There are a variety of audio media such as phonograph records which come in the form of discs using a stylus (needle). The audiotapes have an advantage over phonograph records because the educator can record tapes easily and economically and when the material becomes outdated or no longer useful he can erase the magnetic signal on the tape and reuse it. Another advantage is that broken tapes can be repaired. There are also cassette tapes. These are self-contained reel-to-reel system, with two reels permanently installed in a rugged plastic. The size of plastic cassette containing the tape is the same in all cases, and can be placed on any cassette machine.

The learner may elect to work on an item of study at his/her convenience or when she is most ready to demonstrate mastery rather than at a time for all learners which is dictated by the educator. Self-paced learning ultimately leads to mastery learning whereby learning is dependent of learners aptitude, the quality of instruction, the material for instruction in this case the cassette, the learner's ability to understand the instruction, time spent on learning, which

depends on time allowed for learning and of course the perseverance in learning (Spencer 1996:113).

In teaching young learners the tapes and music records can be used for developing rhythm to teach literacy and mathematical concepts. One other special application of pre-recorded audio media is "talking book programme" used by the visually impaired people.

Mathematical concepts run across the curriculum of most pre-primary schools. In the pre-primary schools there are a variety of learning centres or areas such as the discovery centre, dramatic play centre, which includes home-living or fantasy centre and block-building centre. There is also the art centre as well as learning language and readiness centre.

Mathematics which involves concepts about numbers, measuring, spatial relationships, time and problem solving can be presented to young learners through the various centres mentioned above and in a form that is understandable to them. It is in these centres/areas that educators can find many ways of helping the learners discover some of the basic understanding.

3.7 TECHNOLOGY IN EDUCATION

"Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances student learning" (National Council of Teachers of Mathematics (NCTM) 2000:11). Colleges and educator trainers are charged and challenged with the task of preparing educators who can fully utilize technology as an essential tool for developing a deep understanding of mathematics (Drier 2001:170). The main aim is to

learn with technology rather than learning about technology. This implies that educators must learn to use technology such as computers, television and compact discs as cognitive tools to enhance learners learning of content material.

3.7.1 COMPUTER-BASED INSTRUCTION

Computers have been shown to be effective in a number of areas of education. Education authorities are using the computer to examine a variety of educational issues, from the order in which aspects of learning areas should be taught to the place of the educator in the educational system. Computers like other educational media, will never be able to replace a good educator, rather, it will provide him with an invaluable educational tool. The computer can provide learners with individualized attention which frees the educator to concentrate on the slow and/or gifted learners.

There are two types of computer-based instruction. They are: computer-assisted instruction (CAI) and computer-managed instruction (CMI). In CAI the computer stores the instructional material and controls its sequence. The student, in this case interacts directly with the computer, whereas in the Computer-managed instruction (CMI) the computer helps instructors to administer and guide the instructional process (Anderson 1976:126). The learner is not directly connected with the computer system and the instructional material is not stored in the computer, in exception of information about students and about relevant instructional materials that can be rapidly retrieved.

In computer assisted instruction, (CAI) computers display lesson material, provide drill and practice, reinforce learning, display relevant stimuli and administer tests. Methods that are facilitated effectively by CAI are drill and practice method, which is predominantly used for mathematics drills and foreign languages. Drill and practice programmes provide a variety of questions and the learner gets positive and negative feedback as well as reinforcement. This method works more or less the same as tutorial method whereby the computer acts as an educator, without necessarily replacing the educator.

There are other methods which have been fully explained in the beginning of this chapter, which could be facilitated by the computer, such as: simulation method, discovery method, and problem-solving method. In the case of computer-managed instruction (CMI) the computer is used to manage information about learner performance and learning resource options (Brown et al 1977:23) in order to prescribe and control individual lessons. The computer can help solve management problems regarding student evaluation process by administering diagnostic tests, scoring them and prescribing the next step to be followed. The computer will monitor the learner's progress throughout and keeping records (Anderson 1976:125).

The use of computers have also been shown to improve the rate of learner's learning. This in turn will help to reduce the number of failures, particularly when used in conjunction with other technology such as high quality video. Videos screened on television can be used in conjunction with the computer to provide interactivity.

3.7.2 COMPACT DISC (CD)

The compact disc is more like a mini silver phonographic record which has no grooves. It is 4.72 inches in diameter. It can rotate much faster than a phonograph record. The advantage of a CD is that any part of the disc can quickly be accessed by the user. Information can easily be located and programmed to play in any sequence of the user's desire (Heinich et al 1990:167). Another advantage of a CD is that it cannot just get damaged unless a person is really determined to damage it deliberately. Ordinary scratches do not affect playback of the recording.

The CD works with digital cassette tape recorders. Any material for learning can be digitally recorded however, the cost is very high. According to Heinich et al (1990:67) a single CD can hold as much as 250,000 pages which can easily and quickly be accessed.

3.8 MEDIA AND THE YOUNG LEARNER

Some schools which are well funded have, of late, successfully integrated micro computers in their classrooms (Hannafin et al 1993:28). Earlier research has revealed that teachers resisted to the use of technology with the fear that their positions as teachers would be replaced by technology. Cuban (1989:220) in his review of classroom use of technology found that educators failed to use technology due to their inability to adapt their teaching methods and styles to maximise the potential of these innovations. It is time that there is a shift in the educator's traditional role. He is no longer the dispenser of information to relatively passive learners (Nunan and Lamb 1996:135). Educators are referred to as managers of information (Berliner 1985:53).

Many different approaches to teaching mathematics to very young learners are being used today and many commercial materials are now available in most schools, however this does not rule out the educator home-made teaching/learning materials. Mathematics teaching following rote learning or the unquestionable acceptance, on faith for many of the steps in problem-solving is being discarded and is now being replaced by the emphasis on understanding of how and why the mathematical processes work. Learners need to see, touch, do and understand all about mathematical concepts (Faber et al 1997:113).

Computers have found homes in the classrooms. There are many educators who utilize computers in many challenging and creative ways. Hannafin et al (1993:30) sight an example of the Geometric Supposer series by Schwartz and Yernshalmy (Hannafin et al 1993:45) which enable the learners to deal with geometric shapes without guidance and direction. There are softwares in the market that can be used to teach young learners about numerical concepts and literacy.

There are advantages of using computers in the classroom among others, computers allow for individualized learning, it allows learners control over the rate and sequence of their learning. Colour, music and animated graphics can add realism and appeal to drill exercises, laboratory activities, simulation and so forth (Nunan et al 1996:197).

There are limitations as well, such as the expenditure incurred in the design of instructional material for use with the computer. Individualized learning leads to lack of socialization. There is no face-to-face interaction with the

educator or other learners because the learner works alone with the computer. It is in the interest of education that all the educators and learners be exposed to computer literacy, because computers are here to stay.

Any media that has to be used by young learners in the pre-primary and primary schools should be relevant. The age and level of development of the learners, individually or as a group should be taken into consideration. Some of the media discussed earlier are still relevant for use with young learners. For example, charts and sketches, can be used as back-drop for teaching certain mathematical themes. Flat pictures and number cards stimulate creative expression especially when they are in colour (Faber et al 1997:126). Pictures not only provide bases for answers to factual questions but they may also stimulate a variety of creative expressions (Brown et al 1977:96). The educator can display them in front of the class, and ask relevant questions about each and later pass them for individual study/game/simulation as the case might be. Cards could be placed in a box where learners can access them and examine them individually in detail.

As mentioned, earlier, the uses of audio media are limited only by the imagination of educators. Audio media can be used in the area of self-paced instruction and in mastery learning (Spencer 1996:108). A learner who is keen to understand a particular concept can repeat segments of instruction over and over again because the cassette can serve as an impatient teacher.

The learner may elect to work on an item of study at his/her convenience or when he/she is most ready to demonstrate mastery rather than at a time for all learners which is dictated by the educator. Self-paced learning ultimately

leads to mastery learning whereby learning is dependent of learners aptitude, the quality of instruction, the material for instruction, in this case the cassette, the learner's ability to understand the instruction, time spent on learning, which depends on time allowed for learning and of course the perseverance in learning (Spencer 1996:113) In the teaching of young learners, there are tapes and music records that can be used for developing rhythm to teach literacy and mathematical concepts. One other special application of pre-recorded audio media is "talking book programme" used by the visually impaired people.

Mathematical concepts run across the curriculum of most pre-primary schools. In the pre-primary schools there are a variety of learning centres or learning areas such as the discovery centre, dramatic play centre, which includes home-living or fantasy centre and block-building centre. There is also the art centre as well as language learning and readiness centre.

Mathematics which involves concepts about numbers, measuring, spatial relationships, time and problem solving can be presented to young learners through the various centres mentioned above and in a form that is understandable to them. It is in these centres/areas that educators can find many ways of helping the learners discover some of the basic understanding of mathematics.

Many different approaches to teaching mathematics to very young learners are being used today and many commercial materials are now available in most schools, however this does not rule out the educator home-made teaching/learning materials. Mathematics teaching following rote learning or the unquestionable acceptance, on faith for many of the steps in problem-

solving is being discarded and is now being replace by the emphasis on understanding of how and why the mathematical processes work. Learners need to see, touch, do and understand all about mathematical concepts (Faber et al 1997:113).

3.9 DISCOVERY CENTRE WITH SPECIAL REFERENCE TO SCIENCE AN. MATHEMATICS

Some of the material available in discovery centre are **measuring devices** such as rulers, bathroom scale, pieces of strings, thermometer, calender and tape measure. A **variety of clocks** such as windup alarm, electric alarm, clock radio, cooking timer, battery operated clock and pictures. Pictures of other clocks which cannot be found such as grandfather clock. A **display of coins** and Rand bills, their identity and value. Their shapes can be discussed. A **display of stamps collection**. A discussion could include among others, shapes, size, colour, value which could be found on the stamp. At the water and sand table there could be measuring cups, containers of various sizes and shapes, measuring spoons and funnels. **Conglomeration of objects** learners can group objects in sets in many ways such as colour, shape, size and weight. They could engage themselves in activities such as classification, comparison, seriation, addition, subtraction and one-to-one correspondence or equivalence (De Witt et al 1995:17; Faber et al 1997:124; Mc Shane 1991:217).

3.9.1 Dramatic Play Centre

3.9.1.1 House-living centre

A talk about set of dishes, plates, cups, cutlery and so on. These could be sorted out according to their size and shape. According to De Witt et al

(1995:53) manipulation of objects by young children is based on imagining. They further explain that fantasizing as opposed to imagining may be taken as a source of all creative thought. A talk about one-to-one correspondent or equivalence such as "Are there enough cups and saucers for every one? Are they many, few? If too few how many more are needed? Bathroom scale to weigh themselves and kitchen scale to weigh food.

3.9.1.2 Block-building centre

Call attention to taller, shorter blocks, long and short blocks. Questions such as "Who has more blocks?" "Do you need more blocks to complete the bridge?" could be directed to learners. The educator should call the learner's attention to triangular, rectangular or square and draw their attention to spatial relationship such as, above, up, under, besides, below and so forth (Faber et al 1997:28).

3.9.1.3 Art Centre

To intensify mathematical concepts learning in art centre, the educator must talk about paint jars being empty, half-full and full. This has implications on measurement. When the learners work on the dough/clay/plasticine, the educator must talk about the size of the ball of the moulding material, how the ball can be elongated or cut into small balls. Here, conservation of equivalence in amount is indicated. Geometrical shapes of various sizes could be constructed and pasted to make different designs. Geometric forms and solid cones can be placed on shelves to give the young learners an opportunity to explore the concepts of geometrical forms as solids.

According to Price (1987:42) art and mathematics are not separate subjects especially at Pre-primary and Primary phase. Educators must create opportunities to let art serve mathematics and mathematics to serve art. This will make the learners to enjoy and their grasp of basic concepts will develop.

Collage work can also develop mathematical concepts. For example a summer collage can prompt number and colours of the flowers. A background picture of animals in the park might stimulate questions about the height and length of things.

Printing also establishes a feeling for regularity which is the basis for pattern work (Price 1987:43). Prints of leaves, vegetables, fruits, hands, feet and other items can be used to make sequential patterns. Learners can be fascinated to see the variation in size of sets and will enjoy repeating sets of say one, two, three etc. worked in prints.

3.10 CLASSROOM LEARNING MEDIA

In this section attention is drawn to those media that can be used by learners such as:

3.10.1 Calculators

Teaching young learners to use calculators does not have a negative effect on children (Atkins 1994:22). They can prove to be powerful tools for learning numbers. Calculators can be introduced to young learners so that they can begin to know that they are an integral part of school life. The aim is to get them to be familiar with the keys and to develop a sense of curiosity about what the calculator can do. It gives the learners an opportunity to play with

numbers and they can develop confidence in themselves about mathematics (Atkins 1994:20).

3.10.2 A Ruler

A ruler can be a very interesting teaching aid. Most teachers take it for granted that young learners can pick up a ruler and use it intuitively (Price 1987:36). The manipulative skill of holding and controlling a ruler in conjunction with a pencil need to be taught and practiced first under supervision to avoid incorrect habits being formed, in the same way as holding a pen needs to be taught.

The educator has to demonstrate to the learners on how to use a ruler by sitting alongside of the learners and not opposite them, so that they can copy more easily from the teacher. This demonstration can be taught with unmarked rulers. The learners can be introduced to the concept of a point or a dot. Learners can draw interesting lines and in the process they might indirectly spot a triangle or a rectangle, and be encouraged to colour and name it. The learners can be asked to join dots or draw lines across the dots.

3.10.3 Dictionaries

A dictionary helps the learner to expand his vocabulary and to determine the meaning of new words. A dictionary can help to develop the learner's competence in speaking, writing and reading and he/she will be able to cope with life situations.

3.10.4 Textbooks and reading books

These books are sources of knowledge. Reading is the key to concept

learning. A learner who is able to achieve functional literacy can be able to read and gain information from textbooks. Books have been in use for many years. They are readily available at the least cost.

For learning activities to continue at school learners should have enough textbooks and stationery. Textbooks are books giving instructions on particular learning areas. They are valuable sources from which learners can derive information or tutorial matter. Every lesson the educator gives in class is mainly derived from the textbook. Therefore the textbook enables the pupil to read about the lesson given in class, to revise and to prepare for a test or examination. Without it a learner cannot learn, because he would not have this source of information about the lessons given in class. If he has to borrow one every time he wants to learn, he will not learn as often and as thoroughly as he would like to, and the same would also apply to the learner who will be lending him his textbook. Thus one of them will benefit from the exercise which in addition will dampen their spirit. The only deduction one can make here is that an inadequate supply of textbooks may lead to poor performance.

The above views are ably emphasized by Mwamwenda and Mwamwenda (1987:228) when they state that the role of books in the form of textbooks or reading material cannot be over-emphasized. Long after the pupil has parted from the school on completion of his studies a book will remain his perpetual companion. Even before the learner leaves his teacher, the textbook supplements and compliments the teacher's work. When pupils have access to reading material or textbooks the dividends in school achievement are splendid.

3.10.5 Workbooks

Workbooks are used for the execution of written assignments such as answering questions, making sketches and diagrams, such as drawing pictures and in some cases, filling in answers. Learners engaged in these activities are encouraged to think, to formulate ideas and to read and write.

3.10.6 Atlases

Atlases help the learners to calculate distances, locate towns and countries. Determine degrees of latitude and longitude. It helps the learner to gain a global idea of the earth, and to know the positions of the continents, countries, mountains, rivers and the position of their own towns, region and country. The learners gain the global impression of the location of their country relative to other countries (Kruger et al. 1983:277).

3.10.7 Models and objects

Models and objects can be handled, observed, analysed, felt, smelt, tasted or even listened to. Objects such as plants, insects, tools etc. and models of human heart, ear etc. help the learner to experience the object or model of his attention intensely than by listening to a description or seeing a picture of it.

3.11 CONCLUSION

This chapter has illustrated the various instructional media that can be used in conjunction with appropriate methods to teach learners of all ages mathematical concepts especially young learners in the Pre-primary and Primary schools Most of the material specifically for young learners is easily available. More emphasis is placed on projected and non-projected visual media as well as audio media.

The next chapter will look into media selection taking the following factors into consideration: specific outcomes or objectives, learners' variables and interest, content accuracy and relevancy, teaching environment as well as presentational capabilities.

CHAPTER 4

4. MEDIA SELECTION

4.1 INTRODUCTION

In the previous chapter, a detailed description of the variety of media available in most schools was discussed. However, in this chapter the discussion will entail selection of media and material for instructional purposes. The following factors are taken into consideration:

(a) The learners

Analysis of learners and a match between the learners and the content to be presented. A mismatch can lead to confusion and failure to meet the objectives.

(b) Stated objectives

the aim is to indicate what is expected of the successful learners, and to find out if they are able to do or demonstrate that they have learned? and to verify if the results of learning are observable.

Once the analysis of the learners, the content and the objectives have been identified and stated, it is then that a focus will be on the principles of media selection, the education produced instructional media and modification of available material and finally the procedures for media utilization.

4.2 LEARNER ANALYSIS

Rowntree (1990:40) suggests four factors that will inform the educator about his/her prospective learners. The first is demographics, this will depict the age,

sex, home background, social and cultural background and geographical origin. The economic and cultural level will always influence the choice of instructional media. However, Tichenor in (Mingolarra 1994:26) states that instructional media, like communication media, can widen the inequality gap between learners from affluent economic and cultural background and those from depressing and disadvantaged peers. The second factor is motivation, that is, what the learners hope to gain from the course and what are their hopes and fears as well as their attitude to learning (Tomlinson 1981:161). The third factor is the ability to learn. Do they devote a good percentage of their time to learning. There is need to check the IQ, grade level and reading ability. These would suggest that some media should or should not be used. The fourth factor is the learner's background. It is necessary to find out what knowledge, skills and attitudes they already have with regard to the subject to be taught (Tomlinson 1981:257) and to also find out if they have personal interest and experiences that are relevant. This will help to determine the type of media and the most appropriate method of presentation.

It is good for the educator to know his learners to enable him/her to select the best medium to meet the stated objectives. It might help to look at factors that are critical for making good media and method decisions (Mc Luhan 1964:83). Firstly, the learners can be analysed in terms of general characteristics and secondly, the specific entry competencies that will enable the educator to determine the content and media to be applied.

4.2.1 Learners characteristics

Learners who are grouped together in a classroom differ in many respects. One outstanding difference among individual learners is their interest in a

particular subject and their motivation to learn (Kruger et al 1983:179). Every educator is faced with the challenge of what to do in order to inculcate in his/her learners an interest in and a love for the lesson he/she intends to impart. An analysis of learners' characteristics can help in the selection of both method and media. For example, learners with low reading skills may be reached out more effectively with concrete media. When dealing with learners of a particular ethnic or cultural sub group it might be wise to be sensitive to the cultural identity in selecting particular learning material. If the learners do not show interest toward the subject matter it will be helpful to consider using a highly stimulating approach (Tomlinson 1981:163) such as a dramatic videotape or a simulation game.

Media presentations encourage learners to share the common experiences and that can serve as an important point of reference for subsequent group discussions (Mbambisa et al 1990:112). Analysing learners can be easy for a teacher who has been with learners for a reasonable time, but if the learners are new and the teacher has a little time to observe them and record their characteristics, it might prove to be difficult. It is always wise to ascertain if all or at least a higher percentage of learners are ready for the media and method of instruction you are considering (Lizamore 1978:147). The teacher can also use academic records or interviews for older learners but for young learners the teacher has to device other methods to place the learners according to their age and level of development (Kruger et al 1983:38).

4.2.2 Specific entry competencies

When planning a lesson, the assumption is that the learners do not have the knowledge and skills the teacher is about to impart. In reality this could be a

mistake, if the teacher might not have engaged the learners in a pre-test to determine their capacity. Learners exposed to a subject that is new to them often learn best from structured presentations, based on the learner's prior knowledge (Rowntree 1990:143). Each lesson that the educator gives is aimed at unveiling and opening up the world or reality to the learner. Each lesson is planned to accommodate the needs of the learner. The learning content is obtained from everyday life experience of the child/learner. The teacher must always be keen to know what the learner already knows so that he/she can proceed from the known to the unfamiliar and from the simple to the complex. Pre-tests are normally given before instruction. They are used to measure the content to be taught. If the teacher is satisfied that the learners have mastered what he plans to teach them, then it might be wise not to teach that subject matter.

4.3 INSTRUCTIONAL OBJECTIVES

According to Rowntree (1990:44) an objective is a statement that indicates what successful learners are expected to demonstrate what they have learned. Mager (1992:5) sees objectives as intended results or outcomes rather than the process of instruction. A meaningfully stated objective should succeed in communicating the educator's intent. An objective should be as specific as possible. It is wise to avoid words that are open to a wide range of interpretation. Without an explicit objective, learners will lack direction. They will not know what is expected of them. If an objective is clearly and specifically stated, learning and teaching become objective orientated (Brown et al 1977:6).

A meaningfully stated objective starts by referring to what learners are to achieve after an instruction. It then specifies the behaviour or capabilities to be learned. How the educator wishes the learners to be able to demonstrate the knowledge of the subject matter and the conditions under which the performance is to occur and be observed. Finally, it specifies the degree or criterion of acceptable performance (Kruger et al 1983:133). For an objective to demonstrate an intent, the following characteristics should be taken into consideration:

4.3.1 Learners' Performance

A focus should be on what the learner is doing rather than on what the educator is doing. The desired instructional outcome can either be audible or visible like in the case of a young learner being able to complete a puzzle; being able to conserve number of comparing objects according to length, size, mass and so forth. Thus the most significant and indispensable characteristic of a useful objective is that it describes the type of performance that will be acceptable as an indicator that the learner has achieved the objective (Mager 1992:24).

4.3.2 Learners' Behaviour

A well stated objective is dependent on the verb describing the new capabilities, that the learners will have after the instruction (Nunan et al 1996:29). It is the verb that communicates the intent very clearly if it is stated as an observable behaviour. When stating objectives, the educator should avoid vague terms such as, know; understand; appreciate; internalize; believe and so forth (Wyman 1976:4) rather use words which do not leave you open to misinterpretation such as : The learners will be able to .....

(a)	identify	(g)	select
(b)	sort	(h)	compare
(c)	construct	(i)	assemble
(d)	multiply	(j)	measure
(e)	order	(k)	watch
(f)	classify	(l)	weigh and so forth

The use of future tense "the learner will be able to ....." is a reminder that the educator is referring to the new capabilities that will occur after instruction (Harris 1979:55).

4.3.3 Conditions of occurrence

An objective always indicates the important conditions under which the performance is to occur or observed (Nunan et al 1996:29). The educator should state the objective in such a way that the desired performance and intent will be recognized by another competent person (Heinich et al 1990:38). It is important to state clearly the conditions underlying the performance such as, what the learners are allowed to use or denied. For example, in the case of mathematics, the objective could be "given calculating devices you will be able to ....." OR "Without the aid of references, tables or calculating devices you will be able to ....."

4.3.4 Degree or criterion

The degree or criterion is the final requirement of a well stated objective which indicates the standard by which acceptable performance will be judged (Mager 1992:71). The objective must state what degree of accuracy or proficiency the learner must display. Time limit and accuracy are meaningful dimensions for

many objectives. The objective must state the time limit or how quickly the observable behaviour must be performed. Adding a criterion to an objective is a way of communicating an important aspect of what it is you want your learners to be able to do (Brown et al 1977:6). The criterion is set by answering questions such as : (1) How well must a student be able to perform in order for practice to be the only requirement for improvement (2) How competent must the learner be in order to be ready for the next lesson (Mager 1992:78).

4.4 CLASSIFICATION OF OBJECTIVES

Objectives can be classified under the following five categories. The first three categories are cognitive, affective and motor skill domains. They are followed by, individual differences and interpersonal skills.

4.4.1 Cognitive domain

The learners are expected to grasp and recognise separate and at times unrelated learning experiences into meaningful higher level abstraction and to utilize them in turn, in successful and more complex tasks, media should be used to develop the learners' knowledge and reasoning powers. Media should appeal to the thought processes. Heinich et al (1990:43) postulated an orderly progression from simple to complex mental abilities. However with additional research over four decades, there is a move to incorporate three qualitatively different types of capabilities such as: Verbal/visual information that entails factual or visual knowledge stored in memory. The information can be retrieved and used.

Intellectual skill that has to do with the ability to use symbols to organise and manipulate the environment. The learner gets to understand his experiences as they present themselves to him (De Witt et al 1995:49). The two basic forms of symbols are words and numbers. They allow us to read, write and compute. Cognitive domain has to do with human understanding, ideas convictions and knowledge (Spangenberg, Krech et al 1982:291). Intellectual skills include among others the ability to (a) discriminate between two different stimuli e.g. the difference between the sound of a car and a van). (b) Concept learning involves classification of objects or ideas into categories on the basis of shared attributes. For example in the case of young learners they can classify objects according to colour, texture, size, weight and so forth; (c) Cognitive strategies include among others the ability to visualize, to think and to solve problems. (Tomlinson 1981:55).

4.2.2 Affective domain

This has to do with attitudes and appreciations objectives. It is the degree to which the attitude or value has become part of the individual (Mager 1992:11). For example in appreciation the learner patiently listens attentively when a story is read to the class or directs his attention to a resource material presented by the educator. Later the learner responds by actively participating in the lesson. The learner will ask questions relating to the subject matter, in this case, the story that was read to him. This is finally followed by appreciation. The learner shows interest in the lesson (story) or other stories.

4.4.3 Motor skill domain

This may be seen as progression in the degree of co-ordination required of young learners (Brown et al., 1977:6). Motor skills relates to activities and

performance skills such as imitation. Through imitation the young learner is gradually afforded an opportunity to learn and to achieve. When he fails he seeks means and ways to create a reality which corresponds with his initial observations. Imitation of adults is part and parcel of young learners way of learning (Du Toit & Kruger 1991:82). Manipulation is another activity performed individually. A young learner has patience to playfully learn with manipulative resources. His success depends on a number of practices. This is followed by precision, that is, performing with accuracy and lastly, comes articulation. This entails performing unconsciously, efficiently and harmoniously, incorporating co-ordination of skills. A good example is the ability to write spontaneously without necessarily checking every letter of each written word. The skills that learners will need to develop must be recognized, described and accommodated in the educator's teaching plan.

4.4.4 Objectives and individual differences

Objectives are not intended to limit what the learner should learn (Lizamore 1978:144). They are intended to provide a minimum level of whatever achievement is expected from him. In a mathematics class, learners of mixed ability, for example, the objectives of each learner might be to complete and pass the test with a distinction, but their standards may vary according to their performance because they are individuals with unique qualities (Tomlinson 1981:304). Each learner has a different sphere of experience and each has different characteristics. Because of such individual differences, incidental learning takes different forms with different learners. This calls for great care to be taken when stating objectives for each lesson.

4.4.5 Types of interpersonal skills learning

Interpersonal skills fall into the following categories. The first is searching for **information and sharing information**. After acquiring facts about a concept the tendency is to clarify and offer opinion to another individual who is not clear about the facts surrounding that particular concept The second is **making a proposal**, that is suggesting a course of action or putting forward a new concept. This is followed by **developing and supporting** (Nunan et al 1996:55). Offering or enhancing another person and building his/her ego or self-esteem. One other category is **inclusion or sidelining or exclusion** of others from conversations or discussions, for example an educator who only concentrates on high achievers or who also involves slow learners in class discussions. The next is, **disagreeing or accepting** others' opinion or criticism. The last is **summarizing** that is consolidating facts. Restating in a compact form the content of previous discussions or considerations (Clegg & Billington 1994:103).

4.5 PRINCIPLES OF MEDIA SELECTION

The discussion will centre around selection criteria with reference to generalised principles which suggest several ways in which successful application of media may be achieved. All kinds of media whether print, visual, audio-visual, relia cards, pictures, construction blocks, calculators, logos and so forth; whether presented in machines or hand manipulated will be subject to these guidelines.

4.5.1 Guidelines for media selection

Most educators believe that different criteria are suitable for different situations. For example one educator for young children might decide to use

abacas for teaching number line; another educator might decide to use chalkboard to present the same concept. But what stands out, is that the following principles have to be taken into consideration. The educator must be convinced that:

4.5.1.1 **the objectives of the material matches that of the educator**. The learners must perceive the stimuli that the educator has arranged for them (Heinich et al. 1990:39). The material should be used for a specific purpose. The educator must have definite reasons for the use of the material. Media should not be used merely because they make the lesson more interesting than verbal exposition. Media should not be used simply to prevent restlessness and disorderly behaviour, rather media should be used to inculcate certain attitudes in learners or to explain or demonstrate specific learning content.

4.5.1.2 **there is no one media that can serve all purposes.** Some lessons are best suited for presentation by a particular medium rather than another. The medium should be prepared thoroughly in advance taking into consideration what the learners are to see or hear, what the sequence of events will be. However, based on the behaviours resulting from a sequence of presentations, either another sequence can be started or the same medium can be used in another way. The medium must be relevant and appropriate. Mingolarra (1994:27) sees relevance as an ever-changing criterion which leads one to regard something important in a particular situation defined by their interest and objectives. Coombs (Mingolarra 1994:27) advises that educators must be on the lookout for miscrupulous people who promote a single type of medium as the only means of attaining their objectives.

4.5.1.3 **media must be appropriate for the mode of instruction**

As choice is being made, it may be wise to consider the media suitability when used in the lesson you have in mind (Mbambisa et al 1990:44). The educator must never start by selecting an instructional medium and then look around for an educational problem to solve by using that particular medium. Media should be considered to be only an aid to teaching and learning. They should be used to make the lesson more effective. The lesson should not be designed to suit the media. The media should be integrated into the lesson, and media should not take up too much of the lesson time.

4.5.1.4 **media must fit the level of development and capabilities of the learners as well as their learning style**

The learners preferences, their individual differences are likely to influence the ultimate results of using that media (Farrant 1984:110). Information contained in the particular media should be relevant, up to date and correct. Media should be selected in such a manner that the learners' age, level of development and experience as well as their individual differences are taken into consideration.

4.5.1.5 **media must be chosen objectively rather than on the basis of personal preference**

If, as an educator, one has used the material several times and one feels bored to continue using it, it might be in one's interest to put one's feelings aside and consider that the material might be new to the learners (Heinich et al 1990:49).

4.5.1.6 **media effectiveness is dependent on suitable physical conditions surrounding it**

Improper acoustic, uncontrolled or poor lighting, poor ventilation and other forms of distractions are likely to affect negatively an otherwise excellent media resource. Electrical outlets are needed all over the modern classroom as individuals and small groups use media (Wyman 1976:59).

4.6 EDUCATOR PRODUCED INSTRUCTIONAL MEDIA AND MODIFICATION OF EXISTING MATERIAL AND MEDIA

Most educators prefer to produce material for their own presentations. Some educators of younger learners, in most cases, use discarded material to produce instructional media. However certain basic considerations must be taken into account when an educator decides to produce own material. For example:

4.6.1 **Objectives** : What is it that the educator wants to impart to the learners? And for what particular purpose may the item be used? Media is always selected with a particular objective in mind. In the planning of every lesson careful consideration should be given to the selection of media which are suited to the learning planned for learners.

4.6.2 **Learners** : Do the target learners have the prerequired knowledge and skills to learn from the material? Media should be selected with due consideration of the learner's age, level of readiness, development and experience. Individual differences should also be taken into consideration. For example in the case of audio-visual presentation the level of language usage and the learning content should be understandable to the learners.

4.6.3 **Content** : Is the content current and suitable as well as accurate? Is it set at proper cognitive levels to address the students with whom it will be used? In choosing a medium it must be remembered that what appeals to one learner may not appeal to another. The medium must allow for individual differences. Much as the medium should motivate all the learners, educators must always bear in mind that such an exercise could sometimes be a problem. Media should form a very important part of the teaching-learning situation. The more actively the learner gets involved in the learning situation, the greater is the level of achievement. By feeling, touching, hearing, smelling, seeing, doing and thinking the learner will be highly motivated and his level of understanding will be very high and will be able to retain the content presented to him.

4.6.4 **Cost** : Is it cost effective to produce own material? especially when measured against educational results derived from its use? The educator should be more careful not to find himself buying or producing a medium that will not in the end assist to meet his objectives. Some choice of media is sometimes not readily available because they might be too expensive.

4.6.5 **Appropriateness** : Is the material designed in such a manner that it will communicate the intended objectives. It is important to select media that will arouse and support the child's curiosity. Media can only present the learner with a challenge if it represents something that is unknown to him/her. Such novelty is dependent on the learner's experience and knowledge. The educator needs to use media which appeal to his learner's perception. Media must keep the learner thinking and this thinking should be sustained throughout the lesson. Using appropriate media should assist in the integration of newly acquired knowledge. The learner's existing knowledge and

the newly acquired knowledge should be integrated to form a new meaningful whole. As such media should promote memorization (Kruger et al. 1983). Media must lead to more successful learning. Media should help the teacher to achieve the intended outcomes. Relevance is thus a very important component of learning. If a medium used is irrelevant, the learner will be distracted. It is clear that distraction leads to unsuccessful learning. The learner may even learn the wrong thing as a result of distraction.

4.6.6 **Technical touch :** Is the material technically satisfactory or was it just a time consuming exercise which could have been avoided by using inexpensive material to get the job done. The above mentioned factors should not discourage educators from producing own material. According to Brown et al., (1977:78) educators are encouraged to produce teaching material or instructional media for their lessons, and that some schools have resource centres which are manned by professionals who can help and advise educators, with technical expertise in the production of material of their choice.

4.7 MODIFICATION OF EXISTING MATERIAL

It is always wise not to discard used material and medium. If the educator finds it difficult to locate suitable materials and media he/she might resort to adaptive media production. The technique required is to create new forms of using media resources that already exist. This act can be both challenging and creative. Engaging in this exercise does not involve set directions.

4.8 PROCEDURES FOR MEDIA UTILIZATION

Media, in most cases is readily available (Nunan et al 1996:180) and some can be readily modified to meet particular instructional needs. However, the

ways of using educational media usually emphasizes the need to be consistent with instructional objectives. Media used in conjunction with suitable or appropriate method should help to actualize what is expected from the learner (Brown et al 1977:71) that is, observable results of learning. Basic utilization of educational media entails preview of material, presentation, practice, preparation of the environment, preparation of the learners actual presentation and finally, evaluation.

4.8.1 Preview of material

It is in the interest of the educator to review the contents in advance and to determine that the materials are appropriate for the learners who are to benefit from the presentation as well as the objectives. The educator should study available notes about the material and design his own notes and familiarise himself with the contents (Wong, Au Yeung & Mc Clelland 1992:45). The educator should device a plan on how he will introduce the content, and how he will engage the learners to gain interest and attention and how he will finally wrap up the lesson.

4.8.2 Presentation practice

For effective facilitation to take place the educator should be well-organized and have a well-managed classroom as these would make learners feel the need for learning. Learners in well-managed learning sites know exactly what is expected from them and how and when to perform their daily tasks. A well-organized educator will always have his work well-planned and would come to school fully prepared for the learning area he must facilitate. Good preparation instills confidence in the educator which enables him to face up to the pupil's probing questions. It improves the quality of instruction and

reduces boredom and restlessness. A well-prepared lesson makes learners not only love the educator but love the lesson or learning area as well. It makes learners enjoy their stay at school and makes them eager to learn their lessons. Many disciplinary problems can be prevented if educators prepare their lessons properly. Educators can prevent problems from occurring through good preparation (Troisi 1970:8). Careful planning by the educator does not only assist the learners to master the contents of the course, but it also indirectly helps them learn by increasing their confidence in the educator. Mwamwenda (1990:225) argues that an educator who is well-prepared shines with a sense of self-confidence and his learners will perceive him as well-organized. They will realize that there is a great deal to do and therefore no time to waste.

Practice makes perfect so goes the proverb. It is always advisable to go through the presentation and to review the notes before the ultimate presentation (Kruger et al 1983:140). Some people prefer to practice in front of a mirror, or to make a presentation to colleagues to solicit their feedback. Others would prefer to videotape their presentation to see how they look and how they handle manipulative objectives and so forth. The main aim is not to appear unprepared in front of the learners.

4.8.3 Preparation of the learning environment

Educators cannot facilitate effectively and learners cannot learn effectively if the environment in which they find themselves is not conducive to facilitation and learning. Consequently, the educator should create an environment in his classroom which promotes serious and orderly learning and in which learners can develop socially, emotionally as well as academically. The educator

should introduce his learners to a positive disciplinary code based on clear and fair rules that is established to reinforce positive behaviour rather than punish negative behaviour.

According to Sullivan and Wircenski (1986:27) even though an educator is technically and well-prepared, the physical and psychological conditions in his classroom may well determine his success or failure. Small things like making sure that the classroom is comfortable and clean and that learners' desks are arranged in a way that encourages learning, do count a lot. The educator should promote a supportive environment and use a number of facilitation techniques and media. He should monitor the learners' work and be available to provide answers to learner-initiated questions. He should assume the role of a strong leader (Stockard and Mayberry 1985:21).

Good classroom management is important because it allows the educator to spend more time helping learners to learn. Seating should be comfortable. There should be adequate lighting and ventilation. The room temperature should be suitable for all learners. The light switches should be accessible and that media is in working condition and properly set to allow for proper viewing and hearing. For young learners material should be set at eye level, that effective classroom practices lead to achievement and a climate of success. This brings to the fore the manner in which lessons should be presented in class. The educator should always regard each learner as unique and that should form a base of his/her teaching. He should make it a priority to assist learners in understanding the material taught and demonstrate his/her commitment by helping them learn. He should vary his presentation methods and make learning interesting. According to Townsend-

Butterworth (1992:42) good instruction is creative, lively, yet thoughtful and carefully attuned to the interests and abilities of learners. It is flexible and designed in such a manner that it challenges gifted learners without frustrating the slow learners. Effective teaching practice affords the learners chances to learn.

While educators expect learners to be interested in what they teach, it is often how they present the lesson that determines whether the learner receive and absorb information or become interested. The secret lies in proper usage of appropriate media in the lesson presentation.

The educator should review the material previously taught on a daily basis and check the pupil's homework before commencing with a new lesson. He/she should give learners ample opportunity to ask questions during the lesson and to practise new skills. He/she should give frequent and prompt feedback during question-and-answer sessions and on written tasks, as well as corrective information if a learner makes a mistake.

4.8.4 Preparation of the learners

It is proper to prepare the learners about the presentation that has to be made, by making it clear why such a material is being used. With young learners, the educator need not tell them the objectives, rather a stimulating introduction will help to arouse their interest and attention (Mbambisa et al 1990:44; Rowntree 1990:116). Stimulating questions could be asked to capture and sustain the learners interest. An interested learner normally perceives attentively, concentrates, thinks, asks questions and attempts to solve problems. The

learners are keen to become involved in order to know more and to discover for themselves.

Practitioners of education agree that helping pupils set high but achievable goals for themselves is one major way of getting them motivated. Therefore educators should guide learners in setting specific goals for themselves and assist them in their endeavours to achieve them. As Levine (1988:67-88) explains, some learners set their goals too high, others set them too low and still others do not have any goals. Meeting realistic goals can give learners the sense of power they may be missing. It may also help them become more involved in their own achievement and as a result they may work harder to achieve their goals. According to Bandura (1986) in Alderman (1990:28) goals play an important role in cultivating self-motivation by establishing a target or personal standard by which learners can evaluate or monitor their performance.

4.8.5 Actual presentation

This is the time to show the skill of presentation, by moving with the learners, capturing their interest because where there is interest, attention takes place and where there is attention, learning takes place. Proper use of material in the lesson is sure to yield good results (Kruger et al 1983:140). The educator must direct the learners' thought to the intended learning outcomes. The lesson should be designed in such a manner that it sets the pupils thinking.

A good introduction to the lesson serves to usher-in content that has to be learned. The introduction of a lesson needs only a few minutes yet its importance cannot be underestimated because it serves to link previously

learned material to the learning content to be presented. The introduction of a lesson must be presented such that it offers learners some common ground and some foundation for understanding the new content. The introduction must trigger in the learners a sense of curiosity, it must set the learners wondering and thinking in preparation for the new content that has to be learned.

There is a reciprocal relationship between goal setting and self-monitoring - both processes will lead to one another. Educators should know that when they help pupils to take responsibility for their own learning, they have taken a giant step in promoting motivational equality in the classroom.

Recognition of the learner's outstanding achievement or performance in any sphere at school has been found to have a tremendous influence on enhancing his motivation. Recognition can take the form of praise, merit certificate, prizes, encouragement, high marks, stars or any other kind of reinforcement.

4.8.6 Follow up

Follow up activities help the educator to assess if stated objectives have been met. Practice activities help the learners to recall. Supplementary material are essential to achieve the effects observe. The ultimate question in the utilization of media in conjunction with the chosen method of presentation is whether or not the learners have learned what they were supposed to learn (Heinich et al 1990:57). The primary function of the conclusion phase of the presentation is to summarize what has been presented by repeating the main points. The

most important point to be remembered is that a lesson should never end abruptly after the presentation and mastery of the learning content.

4.9 CONCLUSION

This chapter has illustrated the various factors that have to be taken into consideration when selecting appropriate media and instructional material for use in teaching. The following factors were discussed: Learner analysis, taking the demographics, the learners level of development and their ability to learn as well as individual differences. This was followed by instructional objectives and the classification of objectives with special reference to three categories, which are **cognitive domain** which incorporate capabilities such as verbal/visual information and intellectual skills. Another category is the **affective domain**. This has to do with attitudes and appreciation objectives, and finally, the **motor skill domain** which embraces initiation, manipulation precision and articulation. Motor skills relate to activities and performance skills, mostly by young learners.

Other areas covered are the principles of media selection which suggest several ways in which successful application of media may be achieved. The other area also touched is the educator produced instructional media and modification of existing material and lastly, the procedures for media utilization which entails preview of material, presentation practice, preparation of the learning environment, preparation of the learners and of course the actual presentation and winding up with a follow up.

This chapter forms the base for the actual research activities to be carried out in the pre-primary and primary schools to find out if appropriate media integration in lessons do facilitate learning.

CHAPTER 5

5. EMPIRICAL RESEARCH

5.1 INTRODUCTION

The basic aim of this study is to establish beyond doubt the effect of media integration in the facilitation of mathematical concepts in the pre-primary and primary schools. The objectives are to investigate the factors that influence the learners' cognitive development and also to determine to what extent factors such as learner variables and interest, content accuracy and relevance, learning site and facilitation capabilities of the educators, can impact on media selection.

The problem of poor performance in mathematics in pre-primary and primary schools is experienced country-wide. The possible fundamental cause could be linked to failure by most facilitators in integrating media in their mathematics lessons.

All the previous chapters have probed this problem through the study of literature. In this chapter the problem is subjected to an empirical investigation. The hypothesis will be tested by means of data "gleaned" from mathematics educators pre-primary and primary school learners of the sample schools.

The researcher will give a description of the research sample. This will be succeeded by the indepth discussion of observation method, Interviews and questionnaire methods, which are the methods of investigation used in this study. Thereafter, a description of the procedure followed in the collection of

data for the empirical investigation will be discussed. The data collected will be subjected to a statistical analysis and calculations so that the hypothesis can be tested. This will be followed by data discussions, data analysis and interpretations.

5.2 SAMPLE AND SUBJECTS OF THE RESEARCH

Since it is almost an impossible task to conduct this research in the whole country in order to get to the root of the problem, the researcher has selected Mafikeng District as a study area. The sample will be taken from the population by the researcher to execute her research with it. According to Mulder (1982:52) population refers to a number of people who share the same characteristics as defined by the researcher. A population of study could for example include a group of medicine students in the country, all the pensioners in a particular chosen area, it could refer to a number of learners in the pre-primary and primary schools. It is actually dependent on what the researcher has in mind with his description of the population.

The researcher will thus take a sample from the school's population, that will be, the learners from the selected schools, and a sample from the educators within Mafikeng District to carry out her research. The educators will be randomly selected. According to Nachmias et al (1981:418) it is important to know as much as possible about the population from which a sample has to be drawn, thus the researcher has chosen Mafikeng District which is familiar to her.

The researcher will look out for information that indicate some unusual characteristics that might decrease the validity of the samples used in this

research. The sample in this case will be a representation of the sample in this case, will be a representative of the various schools, that is, pre-primary and primary schools. It is expected that the results and conclusions from the sample will also pertain to the other schools. This implies that the sample is representative of all the other schools, if it is not the case, then that sample cannot be regarded as genuine (Mulder 1982:55; Tuckman, 1978:226).

This research will be conducted in Mafikeng District. Mafikeng city is the capital of North West Province. The area comprises the following villages, Magogong, Ramatlabama, Lomanyaneng, Logageng, Majemantsho, Ramosadi and Signal Hill. The towns surrounding Mafikeng city are, Mmabatho, Montshiwa, Golfview and Riviera Park as well as Leopard Park. Mafikeng District has a variety of settings. It has an urban, semi-urban, rural and semi-rural setting.

There are many pre-primary and primary schools in Mafikeng District. The researcher selected two primary schools from the village and two from the urban area. The same applied with the pre-primary schools. Eight (8) schools will take part in the study: Four (4) are pre-primary schools and four (4) primary schools. Most of the pre-school learners in this research are children of mixed races learning through the medium of English language. It is apparent that certain social practices of their various cultures are still held in esteem by some parents, and some of the pre-school learners are not conversant with the English language.

5.2.1 Primary Schools

Of the four primary schools selected as samples, two are situated in

Lomanyaneng Village. Some of the learners have had an opportunity to go through pre-primary school education and others did not have that exposure. The learners are taught by qualified teachers and they are taught through the medium of English and Setswana.

One other school is situated in Mmabatho Township. The majority of the parents are professionals. Mixed cultures are traceable among the pupils and most of them, if not all, have had pre-primary education and are taught by qualified teachers. The forth school is situated in Mafikeng City. It is both multiracial and multicultural. The parents of the learners are professional and business people and the school has qualified teachers and enough resource material.

5.2.2 Population and allocation of lessons

5.2.2.1 Pre-primary schools

The population of each school is ±100 learners. The total for four pre-primary schools is ±400 learners. However only learners in their last leg of pre-primary school, aged five to six years will take part in the research. In each class there will be about 18 learners which makes a total of ± 72 learners for the four schools. The eighteen learners will be the sample group for each of the four pre-schools. That implies that each sample group will be subjected to one lesson presented by one facilitator. Making a total of four lessons for the pre-primary school research study.

5.2.2.2 Primary schools

The population for each primary schools is ±800 learners. The total for the four primary schools will be 4 x ±800 learners which make a total of ±3200

learners . One class of grade one and another of grade four from each school will take part in the study. They will each be subjected to a lesson presentation. Because of large numbers in the local primary schools, the researcher will request the principals of the schools involved in the research to allow at the most thirty(30) pupils in a class to participate in the research study. The pupils will be randomly selected. A total number of evaluated lessons for both pre-primary and primary schools will be twelve (12). Preferably qualified teachers with more than three years experience in teaching will take part in the study. Apart from the lessons to be presented by the eight sample schools, seventy (70) educators will be requested to complete a questionnaire. The seventy educators will include the eight(8) who will be presenting lessons.

5.3 RESEARCH METHODS

The following research methods will be used for the collection of data:

i) Observation

ii) Questionnaires and

iii) Interviews

5.3.1 The observation method

The main virtue of observation is its directness. The researcher is able to study behaviour as it occurs. The researcher does not have to ask people about their behaviour, all he/she simply does is to watch them do and say things. Looking at, listening, watching and recording the behaviour of the subjects under study are fundamental elements (Betrand and Cebula 1980:215).

The main requirement for observation is to know the behaviour that is being observed and the ability to concentrate and being focussed, since a limited knowledge may cause or lead the observer to miss out on many important aspects. According to Ary et al (1985:206) there is need to have a framework for describing the observed behaviour. He also maintains that it is possible to observe a child talking and interacting with another child or adult and describe many important and interesting aspects of the situation, but not provide information that is necessary for understanding what the child knows.

Observation may take place in a natural setting (De Vos 1998:280). Observational methods might be used in cases where subjects are not willing to co-operate with the researcher or in some cases where subjects are unable to express themselves verbally. The observer can get a clear picture of what is going on by observing the subjects in their familiar environment. The researcher is able to observe how the observed interact with their environment (De Vos 1998:280).

Observation may take place in a laboratory where, sophisticated devices such as one-way-vision mirrors or screens, video cameras and audio-introspectormeters can be used (Nachmias et al 1981:157).

Laboratory observation is the most controlled method of data collection (Nachmias et al 1981:169). It involves introduction of conditions in a controlled environment. Observations in a laboratory are recorded on the spot during the experimental session. After the observatory exercise, the units of observation are assigned to a well-structured category system.

In some cases, the researcher might take part in the activities of the observed. The researcher then becomes a participant observer (Denzin 1989:118). In a case like that, the researcher attempts to share the world view and adopt the perspective of the people in the situation being observed (De Vos 1998:279). According to Patton (1990:273) in ethnography, the researcher, has an opportunity to understand the context in which the people being observed live and share activities and their lives, in other words, the observer wants to get to know more about the observed by "acting" as one of them. The researcher is able to get firsthand experience in discovering and drawing conclusions about what is significant and ultimately gets to know more about certain activities and information that the participants may not be willing to disclose (Nachmias et al 1981:173). In most cases the observer conceals his role as an observer and records his findings in secrecy. The researcher would then gather data and be in a position to understand and interpret the setting and the participants being studied and evaluated. Ethnography is highly criticized by most researchers on methodological and ethical point. It is felt that the researcher and the intent need to be made known to the participants, beforehand because they constitute an invasion of privacy.

5.3.2 The questionnaire method

The foundation of all questionnaires is the question. The questionnaire must translate the research objectives into specific questions. The responses to such questions will be analysed to provide the data. The questions must be phrased in such a manner that the respondents are motivated to supply the necessary information (Nachmais et al 1981:209). However, it must be noted that the questionnaire that is not properly designed can produce a fundamental source of bias in the ultimate results of the survey (Denzin 1989:145). The

questionnaire should be fully structured, that is, questions should be asked in predetermined sequence using identical wording.

There are three types of question structures, that is, the open-ended questions, the close-ended questions and the contingency questions (De Vos 1998:299). The distinction among the three types of questions are, the close-ended questions are easy to analyse whereas open-ended questions are difficult to answer, they probe and demand the respondent to give a rationale for information earlier stated. The contingency question applies to sub-groups of respondents. That is, some questions are relevant to girls or to boys within the given sample. A contingency question can be said to be a special type of close-ended question. In this study, the questionnaire is designed with close-ended questions. In close-ended questions, the respondents are offered a set of answers or statements from which they are asked to choose the one that most closely represents their views.

Close-ended questions are easy to ask and quick to be answered. They do not require any writing by either the respondent and the interviewer. Their analysis is straightforward. Close-ended questions require less motivation to communicate a response on the part of the respondent. Close-ended questions are suitable when the researcher's objective is to get the respondent to express agreement or disagreement with an explicit point of view, but if the researcher wants to know more about how the respondent came about that view, then open-ended question is more appropriate (Nachmias et al 1981:213). In this study, close-ended questions will be used in the questionnaire.

5.3.3 Interview (Face-to-face talk)

An interview is a face-to-face verbal interchange in which one person, the interviewer attempts to illicit information or expressions of opinions or belief from another person or persons (De Vos 1998:297). Interview is like a conversation. Conversation is a give-and-take between two or more persons. It is an informal interchange of thoughts by spoken words (Denzin 1989:12).

According to Powney et al (1987:2) the interview is one of the methods that is mostly used within psychology and least utilized within the theory of sciences. The ability to interview effectively cannot be taken for granted. The interviewer need careful preparation and practice to develop sound and recording skills as well as the ability to analyse and evaluate the data collected (De Vos 1998:301).

Denzin 1989:109) talks about creative interviewing, that creative interviewing is dependent upon attentive listening, he further states that the creative interviewer impinges on another person's world and he/she must build a trusting relationship with that person. Creative interview involves the capacity to be quiet and to sympathetically identify with another's point of view. Persons can only share experiences with each other if they listen to one another (Denzin 1989:109).

Powney et al (1987:7) are of the opinion that an interview is based upon talk and that data could be gathered through direct oral interaction. The exercise involves the person who asks questions and how he/she phrases the questions and on the other hand, is the person who answers the questions.

As stated earlier in chapter one there are three forms of interviews, the schedule standardized interview, the non schedule standardized interview and the non standardized interview. In the schedule standardized interview (SSI) the wording and order of all questions are exactly the same for every respondent (Denzin 1989:104). All the questions are comparable. The differences in their responses cannot be attributed to the instrument but to the apparent variations between the respondents themselves.

According to Benney and Hughes (1956:139) the SSI is anchored on the belief that the respondents have a common vocabulary and the assumption that questions are equally meaningful to each respondent and that the sequence of questions must be identical (Nachmias et al 1981:190). The researcher must order the questions in such a manner that he/she captures the interest and mood of the interviewee. Questions must be placed in such a way that those that elicit interest of the respondent come first, followed by the less interesting questions and ultimately the threatening questions follows, so that if the respondent gets irritated, a major portion of the questions will have been answered (Nachmias et al 1981:225).

Richardson, Dohrenwend and Klein (Denzin 1989:104) are of the opinion that in the unscheduled standardized interview (USI) the interviewer works with a list of information acquired from the respondents. There is no other restriction, the respondent can answer the questions not necessarily in sequence but according to how he/she feels.

In the non standardized interview or unstructured interview (UI) there are no prespecified set of questions used since the.questions are not asked in a

specified order. The interviewer is free to probe various areas. The non-standardized interview works more the same as the USI (Denzin 1989:106).

According to Powney et al (1987:33) there are five pragmatic distinctions of interviewers. However, a single interviewer may embrace more than one category. There are (1) professional interviewers, (2) interviewer as a research designer, (3) interviewer as analyst, (4) interviewer in ethnographic research and (5) non-professional interviewers.

Professional interviewers have no vested interest in the outcome of research. They are professionals in that they earn their living by interviewing and they derive their strengths from the experience and professional skills in directing the interviewees on what is expected of them.

An interviewer can play the role of an analyst. In this case, the interviewer analyses his own report of an interview unlike when analysing the report of an interview carried out by someone else. According to Hull (Powney et al 1987:34), the interviewer as analyst has a vast wealth of information which he/she has gathered, but may decide to report only a fraction of that information. Some researchers treat that excess information as irrelevant.

In most cases, the interviewer in an ethnographic research is known to the subjects of research. The subjects are aware that they are being studied and that information might be solicited from them (Denzin 1989:157). The ethnographic interviews are very informal. What the interviewer does in ethnographic research, is to write personal narratives about the respondents and the responses gathered from the exercise. In some educational research,

the researchers in most cases design and carry out their own interviews. Some researchers might not be very experienced or competent interviewers. One thing they have in common is their commitment to the outcome of the research study. In this particular study, the researcher is also acting as an interviewer.

5.4 COLLECTION OF DATA

Data refers to information gathered as a basis of references. It is normally in the form of facts or statistics that can normally be analysed or used for further calculations (Hawkins and Allen 1991:367). The collection of data is the most important step of research. Without it, research cannot be conducted conclusively. Butcher (1991:368) regards data as facts or information from which things may be deduced.

The following exposition outlines the procedure applied for the collection of data in this research. In addition to the literature study undertaken, an empirical investigation was launched to establish beyond doubt the effect of media integration in the teaching of mathematical concepts in the pre-primary and primary schools. One of the objectives was to determine the factors that influence the learners cognitive development and another objective was to determine to what extent factors such as learner variables and interest, content accuracy and relevance as well as the facilitation capabilities of the educators can impact on media selection.

Data used for this purpose were gleaned by means of lesson observation in the pre-primary and primary schools, a questionnaire completed by educators and an interview of educators who presented the lessons.

5.4.1 Observation

The observation exercise was carried out on eight lessons presented by educators in the pre-primary school and on eight lessons presented by educators in the primary school. The pre-primary schools which were involved were the Ladybird Pre-primary school, Jack & Jill Pre-primary school, Alpha Pre-primary school and the Pink ELC. The primary schools were, D.P. Kgotleng Primary School; Connie Minchin Primary School; Sol Plaatjie Primary School, and Mafikeng Preparatory School.

The researcher visited all the sample schools mentioned above to inform them about the nature and value of the research to be undertaken. The researcher discussed with the principals of the said schools, about the proceedings and instructions to be followed during the lesson observation. An agreement was reached that the researcher would sit-in and observe the lesson presentation, and there after interview the educators who presented the lessons.

Each educator submitted on the day of lesson presentation; the lesson plan/activity plan indicating the following:

i) The lesson topic / activity topic
ii) Time
iii) Intended learning outcomes
iv) Content
v) Relevant media
vi) Evaluation and conclusion

5.4.1.1 Lesson observation guide

A five-point scale observation guide was used to capture and rate the following points:

(a) Lesson plan layout

(b) Presentation and mediation capabilities of the educator

(c) Integration of media in the lesson

(d) Learners' performance

(e) Logistics

In the lesson plan layout, the following points were observed:

(a) The relevance of the topic of the lesson as well as the relevance of the intended learning outcomes that were stated or implied.

Presentation and mediation capabilities of the educator

(a) Sufficient and appropriate knowledge about the content of the lesson

(b) Meaningful organization of the content

(c) Integration of media in the lesson

(d) Motivation and ability to notice learners who needed extra support

(e) Interaction with learners and encouraging them to fully participate in the lesson

The following points were also observed **in the integration of media in the lesson:**

(a) The type of media used in the lesson

(b) The appropriateness and effectiveness of media in the lesson

(c) The cost effectiveness of the media used in the lesson

Observation also focussed **on the participation of the learners in the lesson**. The observer checked :

(a) whether the learners enjoyed the lesson

(b) whether the learners found the educator's explanation of concepts understandable

(c) Whether the learners knew what the educator expected of them

(d) Whether the learners did learn anything from the lesson.

The logistics did not escape the observer's attention. The following points were observed: suitability of light in the classroom as well as the sufficiency of desks and media for learners. A five-point-scale lesson observation guide form was completed and data collected was subjected to statistical analysis and interpretation.

5.4.2 Completion of a questionnaire

The questionnaire was designed to gather data and to establish the following views:

5.4.2.1 General views

(a) **Possible effects of media in the teaching of mathematics lessons**

The following statements solicited the "agree" or "disagree" responses from the respondents to the questionnaire:

* That mathematics could be taught effectively with the use of appropriate media and that properly designed media could enhance and promote learning.

* That the effective use of instructional media must tap the powerful and undeveloped potential of the learner

(b) **Media selection** The statements touched on:

* the effects of a match between the characteristics of the learner and media
* the match between the content of the lesson and its presentation method
* the socio-economic status, the learner's age and level of development as factors that determine the type of media to be utilized to make learning meaningful to him/her.

5.4.2.2 Personal views

Integration of media in mathematics lessons. This category of statements solicited personal responses from educators about the following:

* media utilization in the teaching of mathematics lessons
* keeping inventories to measure the frequency of media usage
* allowing learners to experience utilization of educational media in their lessons
* the need to know one's learners to enable one to select the best media to meet their intended learning outcomes.

(c) Availability of media in schools. The aim of the statements were to seek information about the availability of educational media and a resource room in their various schools.

5.4.3 Pilot study

Before the questionnaire was distributed, a pilot study was carried out. A pilot

study is a test carried out by a researcher on a small number of persons having same characteristics as those of the persons targeted in the research (De Vos 1998:179). The pilot study was executed in the same manner as the main investigation. The researcher discussed all the procedures and instructions to be followed when completing the questionnaire. The main objective was to find out if the content was understandable to the respondents.

The questionnaire were completed and returned to the researcher. Going through them gave the researcher an indication that the questionnaire wording and phrasing was appropriate to the respondents.

In the next phase, the questionnaire was distributed to the seventy educators. Each questionnaire was accompanied by an instruction note on how to complete the questionnaire form. A cover letter indicating an introductory statement and an explanation of the purpose of the study was addressed to the respondents. Included was an assurance to the respondent that the information provided by him or her, will be held in strict confidence. The cover letter requested the respondent to return the completed form within one week.

The completed questionnaire of each respondent was checked and were found to be in order. Gathered data were subjected to statistical analysis and interpretation.

5.4.4 Interview of educators

The researcher made it a point to re-assure each of the educators who presented the lesson; that whatever information they disclosed during the interview, would be kept confidential. The researcher also tried to establish a

cordial atmosphere so that the educator (interviewee) could feel secure and be willing to share information. According to De Vos (1998:301) interviewers should bear in mind that a prospective interviewee is under no obligation to grant an interview, and answer (often personal) question on the day of the interview.

The researcher allowed a short break after the educator's presentation of the lesson and later proceeded with the interview. The researcher reached an agreement with the educators to have the interview tape recorded. The interview was unstructured. The interviewee was allowed to talk until saturation occurred. The tape recorded information was scripted and subjected to statistical analysis and interpretation.

5.4.5 Data analysis and interpretation

There are statistical techniques which have been used to determine the correlation (degree of agreement) between variables. In this study the following statistical techniques were used, the Wilcoxon Signed Ranks Test, the Pearson Correlation Coefficient, the NPar Tests and Friedman Test.

Data analysis and interpretation which follows hereunder are based on the lessons observation, questionnaire completed by educators and educators' interview. The data will be discussed accordingly.

QUESTIONNAIRE ON THE USE OF MEDIA

5.4.6 RESEARCH PROBLEM 1

EDUCATORS GENERAL VIEWS

i) Possible effects of media in the teaching of mathematics

Table 1

Frequencies and percentages of educators' views if mathematics can be taught effectively with the use of appropriate media.

		Frequency	Percent
Valid	definitely disagree	1	1.4
	neutral	1	1.4
	agree	1	1.4
	definitely agree	67	95.7
	Total	70	100.0

The above table indicates that the majority, 95.7 percent, definitely agree that mathematics can be taught effectively with the use of appropriate media.

Table 2

Frequencies and percentages of educators' views if properly designed educational media can enhance and promote learning

		Frequency	Percent
Valid	definitely disagree	1	1.4
	neutral	1	1.4
	agree	3	4.3
	definitely agree	65	92.9
	Total	70	100.0

The above table indicates the majority, 92.9 percent, definitely agree that properly designed educational media can enhance and promote learning.

Table 3

Frequencies and percentages of educators' views if learners perform better when lessons are accompanied by instructional media

		Frequency	Percent
Valid	definitely disagree	1	1.4
	neutral	6	8.6
	agree	2	2.9
	definitely agree	61	87.1
	Total	70	100.0

The above table indicates the majority of 87.1 percent, definitely agree that learners perform better when lessons are accompanied by instructional media.

Table 4

Frequencies and percentages of educators' views if the effective use of instructional media can tap the powerful and undeveloped potential of the learner.

		Frequency	Percent
Valid	disagree	2	2.9
	neutral	16	22.9
	agree	9	12.9
	definitely agree	43	61.4
	Total	70	100.0

The above table indicates that the majority, 61 percent definitely agree that the effective use of instructional media must tap the powerful and undeveloped potential of the learner.

Table 5

Frequencies and percentages of educators' views. If some of the educators feel confident when using instructional media in teaching mathematics.

		Frequency	Percent
Valid	disagree	3	4.3
	neutral	19	27.1
	agree	8	11.4
	definitely agree	40	57.1
	Total	70	100.0

The above table indicates that the majority, 57.1 percent definitely agree that some educators feel confident when using instructional media in teaching mathematics.

i) Media Selection

Table 6

Frequencies and percentages of educators' views if there must be a match between the characteristics of the learner and media.

		Frequency	Percent
Valid	definitely disagree	4	5.7
	disagree	3	4.3
	neutral	10	14.3
	agree	11	15.7
	definitely agree	42	60.0
	Total	70	100.0

The above table indicates that the majority, 60 percent definitely agree that there must be a match between the characteristics of the learner and media.

Table 7

Frequencies and percentages of educators' views if there must be a match between the content of the lesson and its presentation method.

		Frequency	Percent
Valid	definitely disagree	2	2.9
	neutral	1	1.4
	agree	4	5.7
	definitely agree	63	90.0
	Total	70	100.0

The table above indicates that the majority 90 percent definitely agree that there must be a match between the content of the lesson and its presentation method.

Table 8

Frequencies and percentages of educators' views if good selection of relevant and appropriate media for teaching mathematics always yields good performance results.

		Frequency	Percent
Valid	disagree	1	1.4
	neutral	3	4.3
	agree	6	8.6
	definitely agree	60	85.7
	Total	70	100.0

The table above indicates that the majority 85.7 percent definitely agree that good selection of relevant and appropriate media for teaching mathematics always yields good performance results.

Table 9

Frequencies and percentages of educators' views if socio-economic factors help to determine the level of the lesson and the media to be utilized to make learning meaningful to the learner.

		Frequency	Percent
Valid	definitely disagree	3	4.3
	disagree	1	1.4
	neutral	11	15.7
	agree	9	12.9
	definitely agree	46	65.7
	Total	70	100.0

The table above indicates that the majority, 65.7 percent definitely agree that socio-economic factors help to determine the level of the lesson and the media to be utilized to make learning meaningful to learners.

Table 10

Frequencies and percentages of educators' views if age determines media to be utilized to make learning meaningful to the learner.

		Frequency	Percent
Valid	definitely disagree	6	8.6
	disagree	7	10.0
	neutral	6	8.6
	agree	11	15.7
	definitely agree	38	54.3
	Total	68	97.1
Missing	System	2	2.9
Total		70	100.0

The above table indicates that the majority, 54.3 percent definitely agree that age determines media to be utilized to make learning meaningful to the learner.

Table 11

Frequencies and percentages of educators' views if the level of development of the learner determines media to be utilized to make learning meaningful to the learner.

		Frequency	Percent
Valid	definitely disagree	2	2.9
	disagree	4	5.7
	neutral	8	11.4
	agree	12	17.1
	definitely agree	40	57.1
	Total	66	94.3
Missing	System	4	5.7
Total		70	100.0

The above table indicates that the majority 57.1 percent definitely agree that the level of development of the learner determines media to be utilized to make learning meaningful to the learner.

TEACHERS PERSONAL VIEWS

Interpretation of media in mathematics lessons

Table 12

Frequencies and percentages of educators' views if they always allow their learners to experience the utilization of educational media.

		Frequency	Percent
Valid	definitely disagree	2	2.9
	disagree	2	2.9
	neutral	10	14.3
	agree	11	15.7
	definitely agree	43	61.4
	Total	68	97.1
Missing	System	2	2.9
Total		70	100.0

The above table indicates the majority, 61.4 percent, definitely agree that they always allow their learners to experience the utilization of educational media.

Table 13

Frequencies and percentages of educators' views if they keep media utilization inventories to measure the frequency of media usage.

		Frequency	Percent
Valid	definitely disagree	6	8.6
	disagree	8	11.4
	neutral	19	27.1
	agree	17	24.3
	definitely agree	17	24.3
	Total	67	95.7
Missing	System	3	4.3
Total		70	100.0

The above table indicates a tie of both educators who agree 24.3 percent and those who definitely agree, 24 percent that they always keep media utilization inventories to measure the frequency of media usage.

Table 14

Frequencies and percentages of educators' views if they always preview the educational media well in advance of formal presentation.

		Frequency	Percent
Valid	definitely disagree	4	5.7
	disagree	3	4.3
	neutral	9	12.9
	agree	10	14.3
	definitely agree	41	58.6
	Total	67	95.7
Missing	System	3	4.3
Total		70	100.0

The table indicates that the majority, 58.6 percent definitely agree that they always preview the educational media well in advance of formal presentation.

Table 15

Frequencies and percentages of educators' views if they must know their learners in order to select the best medium to meet specific outcomes.

		Frequency	Percent
Valid	definitely disagree	3	4.3
	neutral	1	1.4
	agree	12	17.1
	definitely agree	53	75.7
	Total	69	98.6
Missing	System	1	1.4
Total		70	100.0

The table above indicates that the majority, 75.7 percent definitely agree that they must know their learners in order to select the best medium to meet specific outcomes.

Table 16

Frequencies and percentages of educators' views if they would like to be exposed to the criteria for making appropriate selection of media for use in mathematics lessons.

		Frequency	Percent
Valid	definitely disagree	1	1.4
	neutral	6	8.6
	agree	12	17.1
	definitely agree	50	71.4
	Total	69	98.6
Missing	System	1	1.4
Total		70	100.0

The table above indicates that the majority, 71.4 percent definitely agree that they would like to be exposed to the criteria for making appropriate selection of media for use in mathematics lessons.

Table 17

Frequencies and percentages of educators' views if they prefer to design their own educational media to serve their learners precisely and to meet specific outcomes.

		Frequency	Percent
Valid	definitely disagree	3	4.3
	disagree	2	2.9
	neutral	9	12.9
	agree	14	20.0
	definitely agree	41	58.6
	Total	69	98.6
Missing	System	1	1.4
Total		70	100.0

The table above indicates that the majority, 58.6 percent definitely agree that they prefer to design their own educational media to serve their learners precisely and to meet specific outcomes.

Table 18

Frequencies and percentages of educators' views if they have been exposed to media integrated learning during their school years.

		Frequency	Percent
Valid	definitely disagree	23	32.9
	disagree	7	10.0
	neutral	12	17.1
	agree	5	7.1
	definitely agree	20	28.6
	Total	67	95.7
Missing	System	3	4.3
Total		70	100.00

The table above indicates that the majority, 32.9 percent definitely disagree that they have been exposed to media integrated learning during their school years.

AVAILABILITY OF MEDIA

Table 19

Frequencies and percentages of educators' views if their schools have resource rooms.

		Frequency	Percent
Valid	definitely disagree	38	54.3
	disagree	1	1.4
	neutral	5	7.1
	agree	12	17.1
	definitely agree	14	20.0
	Total	70	100.0

The table above indicates that the majority 54.3 percent definitely disagree that their schools have resource rooms.

Table 20

Frequencies and percentages of educators' views if they know how to operate educational media available in their schools.

		Frequency	Percentage
Valid	definitely disagree	20	28.6
	disagree	3	4.3
	neutral	7	10.0
	agree	8	11.4
	definitely agree	32	45.7
	Total	70	100.0

The table above indicates that the majority, 45.7 percent definitely agree that they know how to operate educational media available in their schools.

Table 21

Frequencies and percentages of educators' views if there are enough instructional media in their schools to meet a variety of specific outcomes.

		Frequency	Percent
Valid	definitely disagree	28	40.0
	disagree	6	8.6
	neutral	13	18.6
	agree	9	12.9
	definitely agree	14	20.0
	Total	70	100.0

The table above indicates that the majority, 40 percent definitely disagree that there are enough instructional media in their schools to meet a variety of specific outcomes.

Table 22

Frequencies and percentages of educators' views if the instructional media for teaching mathematics in their schools are in working condition.

		Frequency	Percent
Valid	definitely disagree	24	34.3
	disagree	7	10.0
	neutral	14	20.0
	agree	6	8.6
	definitely agree	19	27.1
	Total	70	100.0

The above table indicates that the majority, 34.3 percent definitely disagree that the instructional media for teaching mathematics in their schools are in working condition.

Table 23

Frequencies and percentages of educators' views if they sometimes discuss the availability of media in their schools with their principals.

		Frequency	Percent
Valid	definitely disagree	7	10.0
	disagree	3	4.3
	neutral	11	15.7
	agree	15	21.4
	definitely agree	34	48.6
	Total	70	100.0

The table above indicates that the majority, 48.6 percent definitely agree that they sometimes discuss the availability for media in their schools with their principals.

5.4.7 RESEARCH PROBLEM 2

Is there a significant correlation between the following variables?

possible effects of media in the teaching of mathematics lessons

media selection

integration of media in mathematics lessons

availability of media in schools

H_{02}:

There is no significant correlation between the following variables.

H_2:

There is a significant correlation between the following variables.

possible effects of media in the teaching of mathematics lessons

media selection

integration of media in mathematics lessons

availability of media in schools

THE RESULTS OF THE ABOVE PROBLEM

Table 24 Correlation between, media variables and their significance

Media variables	Correlation	Significance
Possible effects of media in the teaching of mathematics lessons and media selection	.536	$p < 0.01$
Possible effects of media in the teaching of mathematics lessons and integration media in mathematics lessons	.321	$p < 0.01$
Possible effects of media in the teaching of mathematics lessons and availability of media in schools	-.192	$p > 0.05$
Media selection and integration of media in mathematics lessons	.376	$p < 0.01$
	-.069	$P > 0.05$
Media selection and availability of media in schools	.296	$P < 0.05$
Integration of media in mathematics lessons and availability of media in schools		

According to Table 24:

(a) the *availability of media* in schools correlate negatively with *possible effects of media* in teaching of mathematics lessons and with *media selection*. This means as the one variables increases, the other variable decreases however, these correlations are very low and are not significant;

(b) *Integration of media* in mathematics lessons and *availability of media* in schools has a low, positive correlation which is significant on the 5% level of significance - this means the null hypothesis may be rejected and as the one variable increases, the other variable also increases (and vice versa);

(c) *Integration of media* in mathematics lessons correlates positively with *possible* effects of media in the teaching of mathematics lessons (low correlation) and *media selection* (moderate correlation) - these correlations are significant on the 1% level of significance - this means the null hypothesis may be rejected and as the one variable increases, the other variable also increases (and vice versa).

5.4.8 RESEARCH PROBLEM 3:

Is there a significant difference in the average scores of teachers towards the following variables.

possible effects of media in the teaching of mathematics lessons

media selection

integration of media in mathematics lessons

availability of media in schools

H_{03}:

There is no significant difference in the average scores of teachers towards the following variables.

H_3:

There is a significant difference in the average scores of teachers towards the following variables.

possible effects of media in the teaching of mathematics lessons

media selection

integration of media in mathematics lessons

availability of media in schools

Because of the fact that there was not a normal distribution of data, the Wilcoxon Signed ranks Test was employed. The averages and the results of the Wilcoxon Signed Ranks Test appear in Tables 25 and 26.

Table 25 Average scores of the variables

Variables	N	Mean
Possible effects of media in the teaching of mathematics lessons	70	4.6143
Media selection	70	4.4052
Integration of media in mathematics lessons	70	4.0588
Availability of media in schools	70	3.0629

Table 26 Significance of differences in average scores

Pair	z-value	Significance
Possible effects of media in the teaching of mathematics lessons and media selection	-3.028	$p < 0.05$
Possible effects of media in the teaching of mathematics lessons and integration of media in mathematics lessons	-5.536	$p < 0.01$
Possible effects of media in the teaching of mathematics lessons and availability of media in schools	-6.298	$p < 0.01$
Media selection and integration of media in mathematics lessons	-3.488	$p < 0.01$
Media selection and availability of media in schools	-6.062	$P < 0.01$
Integration of media in mathematics lessons and availability of media in schools	-6.606	$p < 0.01$

Table 26 indicates that all the averages differ significantly from one another so that the null-hypothesis my be rejected. These differences are all on the 1%-level, except for the mathematics lessons and *media selection* - this difference is on the 5%-level of significance.

OBSERVATION GUIDE

5.4.9 RESEARCH PROBLEM 4:

FREQUENCY TABLE

What do teachers observe regarding the use of media for teaching mathematics? (Table 27 to 57)

(a) LESSON PLAN LAYOUT

Table 27

Frequencies and percentages of the observer's view if the topic of the lesson was relevant.

		Frequency	Percent
Valid	well done	2	16.7
	excellent	10	83.3
	total	12	100.0

The table above indicates 83.3 percent (excellent) that the topic of the lesson was relevant.

Table 28

Frequencies and percentages of the observers view if the intended outcomes were clearly stated.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	2	16.7
	excellent	9	75.0
	Total	12	100.0

The table above indicates 75 percent (excellent) that the intended outcomes were clearly stated.

(b) PRESENTATION AND MEDIATION CAPABILITIES OF THE EDUCATOR

Table 29

Frequencies and percentages of the observers, view if the educator linked the lesson to the learners' previous knowledge.

		Frequency	Percent
Valid	well done	4	33.3
	excellent	8	66.7
	Total	12	100.0

The table above indicates 66.7 percent (excellent) that the educator did link the lesson to the learners' previous knowledge.

Table 30

Frequencies and percentages of the observers view that the educator used skilful questioning to encourage learners to think and use knowledge already acquired.

		Frequency	Percent
Valid	well done	5	58.3
	excellent	7	41.7
	Total	12	100.0

The table above indicates that the majority 58.3 percent (excellent) that the educator used skilful questioning to encourage the learners to think and use knowledge already acquired.

Table 31

Frequencies and percentages of the observers' view if the educator had sufficient knowledge about the content of the lesson.

		Frequency	Percent
Valid	excellent	12	100.0

The above table indicates 100 percent (excellent) that the educator had sufficient knowledge about the content of the lesson.

Table 32

Frequencies and percentages of the observer's view if the educator organised the content meaningfully.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	2	16.7
	excellent	9	75.0
	Total	12	100.0

The above table indicates 75 percent (excellent) that the educator organised the content meaningfully.

Table 33

Frequencies and percentages of the observer's view if the educator knew what she/he wanted to teach.

		Frequency	Percent
Valid	poor	1	8.3
	moderate	1	8.3
	well done	1	8.3
	excellent	9	75.0
	Total	12	100.0

The table above indicates 75% percent (excellent) that educator knew exactly what he/she wanted to teach.

Table 34

Frequencies and percentages of the observer's view if the educator used good oral instructions to set the scene and to explain tasks to the learner.

		Frequency	Percent
Valid	well done	4	33.3
	excellent	8	66.7
	Total	12	100.0

The table above indicates 66.7 percent (excellent) that the educator used good oral instructions to set the scene and to explain tasks to the learners.

Table 35

Frequencies and percentages of the observer's view if the educator integrated media in the lesson she/he presented.

		Frequency	Percent
Valid	well done	4	33.3
	excellent	8	66.7
	Total	12	100.0

The table above indicates 66.7 percent (excellent) that the educator integrated media in the lesson he/she presented.

Table 36

Frequencies and percentages of the observer's view if the educator managed to get the learners to participate in the lesson.

		Frequency	Percent
Valid	well done	4	33.3
	excellent	6	50.0
	Total	10	83.3
Missing	System	2	16.7
total		12	100.0

The table above indicates 50 percent (excellent) that the educator managed to get the learners to participate in the lesson.

Table 37

Frequencies and percentages of observer's view if the educator used praise and motivation.

		Frequency	Percent
Valid	well done	7	58.3
	excellent	4	33.3
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 58.3 percent (well done) that the educator used praise and motivation.

Table 38

Frequencies and percentages of the observer's view if the educator noticed learners who needed extra support.

		Frequency	Percent
Valid	moderate	3	25.0
	well done	6	50.0
	excellent	2	16.7
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 50 percent (well done) that the educator managed to notice learners who needed extra support.

Table 39

Frequencies and percentages of the observer's view if the educator used continuous assessment as an aid to the learning process.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	5	41.7
	excellent	6	50.0
	Total	12	100.0

The table above indicates 50 percent (excellent) that the educator used continuous assessment as an aid to the learning process.

(c) INTEGRATION OF MEDIA IN THE LESSON

Table 40

Frequencies and percentages of the observer's view about the quality of media used in the lesson.

		Frequency	Percent
Valid	well done	5	41.7
	excellent	7	58.3
	Total	12	100.0

The table above indicates 58.3 percent (excellent) that the observer was satisfied about the quality of media that was used.

Table 41

Frequencies and percentages of the observer's view if the media was appropriate.

		Frequency	Percent
Valid	moderate	2	16.7
	well done	3	25.0
	excellent	7	58.3
	Total	12	100.0

The table above indicates 58.3 percent (excellent) that the observer was satisfied about the appropriateness of media that was used.

Table 42

Frequencies and percentages of the observer's view if media helped to arouse learners' interest.

		Frequency	Percent
Valid	well done	3	25.0
	excellent	8	66.7
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 66.7 percent (excellent) that media did help to arouse the learners' interest.

Table 43

Frequencies and percentages of the observer's view if the educator used media to sustain learners' interest.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	4	33.3
	excellent	6	50.0
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 50 percent (excellent) that the educator used media to sustain learners' interest.

Table 44

Frequencies and percentages of the observer's view if media helped to promote participation of learners in the lesson.

		Frequency	Percent
Valid	well done	5	41.7
	excellent	6	50.0
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 50 percent (excellent) that media did help to promote participation of learners in the lesson.

Table 45

Frequencies and percentages of observer's view if there was evidence of effectiveness of media in the lesson.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	3	25.0
	excellent	4	33.3
	Total	8	66.7
Missing	System	4	33.3
Total		12	100.0

The table above indicates 33.3 percent (excellent) that there was evidence of effectiveness of media in the lesson.

Table 46

Frequencies and percentages of observer's view if the media used was cost effective in terms of learners' achievement.

		Frequency	Percent
Valid	well done	5	41.7
	excellent	5	41.7
	Total	10	83.3
Missing	System	2	16.7
Total		12	100.0

The table above indicates a tie percentage of (both excellent and well done) performance that the media used was cost effective in terms of learners' achievement.

(d) LEARNERS PERFORMANCE

Table 47

Frequencies and percentages of the observer's view if the learners enjoyed the lesson.

		Frequency	Total
Valid	well done	5	41.7
	excellent	7	58.3
	Total	12	100.0

The table above indicates 58.3 percent (excellent) that the learners did enjoy the lesson.

Table 48

Frequencies and percentages of the observer's view if the learners participated in groups or pairs.

		Frequency	Percent
Valid	poor	1	8.3
	moderate	4	33.3
	well done	2	16.7
	excellent	5	41.7
	Total	12	100.0

The table above indicates 41.7 percentage (excellent) that the learners participated in groups and pairs.

Table 49

Frequencies and percentages of the observer's view if the learners found the explanations clear.

		Frequency	Percent
Valid	moderate	2	16.7
	well done	8	66.7
	excellent	2	16.7
	Total	12	100.0

The table above indicates 66.7 percent (well done) that the learners found the explanations clear.

Table 50

Frequencies and percentages of the observer's view if the learners found the activities meaningful.

		Frequency	Percent
Valid	well done	6	50.0
	excellent	5	41.7
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 41.7 percent (excellent) that the learners found the activities meaningful.

Table 51

Frequencies and percentages of the observer's view if the learners knew what the educator expected of them.

		Frequency	Percent
Valid	well done	6	50.0
	excellent	5	41.7
	Total	11	91.7
Missing	System	1	8.3
Total		12	100.0

The table above indicates 41.7 percent (excellent) that the learners knew what the educator expected of them.

Table 52

Frequencies and percentages of the observer's view if the learners did anything constructive during the lesson.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	5	41.7
	excellent	6	50.0
	Total	12	100.0

The table above indicates 50 percent (excellent) that the learners performance was constructive.

Table 53

Frequencies and percentages of the observer's view if the learners did learn anything from the lesson.

		Frequency	Percent
Valid	well done	5	41.7
	excellent	5	41.7
	Total	10	83.3
Missing	System	2	16.7
Total		12	100.0

The table above indicates a tie of 41.7 percent (excellent and well done) that the learners did learn something from the lesson that was presented.

LOGISTICS

Table 54

Frequencies and percentages of the observer's view if there were enough desks for the learners.

		Frequency	Percent
Valid	well done	2	16.7
	excellent	10	83.3
	Total	12	100.0

The table above indicates 83.3 percent (excellent) that the desks were enough for the learners.

Table 55

Frequencies and percentages of the observer's view if there was enough light in the classroom.

		Frequency	Percent
Valid	well done	1	8.3
	excellent	11	91.7
	Total	12	100.0

The table above indicates 91.7 percent (excellent) that there was enough light in the classroom.

Table 56

Frequencies and percentages of the observer's view if there were enough media for the learners.

		Frequency	Percent
Valid	moderate	1	8.3
	well done	3	25.0
	excellent	8	66.7
	Total	12	100.0

The table above indicates 66.7 percent (excellent) that media were enough for the learners.

Table 57

Frequencies and percentages of the observer's view if the lesson was completed to the satisfaction of both the learners and the educator.

		Frequency	Percent
Valid	well done	2	16.7
	excellent	8	66.7
	Total	10	83.3
Missing	System	2	16.7
Total		12	100.0

The table above indicate 66.7 percent (excellent) that the lesson was completed to the satisfaction of both learners and the educator.

5.4.10 RESEARCH PROBLEM 5:

Is there a significant correlation between the following variables?

lesson plan layout

presentation and mediation capabilities of educator

integration of media in the lesson

learners' performance

logistics

H_{05}

There is no significant correlation between the following variables:

H_5:

There is significant correlation between the following variables:

lesson plan layout

presentation and mediation capabilities of educator

integration of media in the lesson

learners' performance

logistics

The results appear in Table 58.

Table 58 Correlation between observation variables and their significance

Observation variables	Correlation	Significance
Lesson plan layout and presentation and mediation capabilities of educator	.588	$p < 0.05$
Lesson plan layout and integration of media in the lesson	.356	$P > 0.05$
Presentation and mediation capabilities of educator integration of media in the lesson	.843	$p < 0.01$
	.522	$p > 0.05$
Learner's performance and lesson plan layout		
Learner's performance and presentation and mediation capabilities of educator	.713	$p < 0.01$
Learner's performance and integration of media in the lesson	.554	$p > 0.05$
	-.176	$P > 0.05$
Logistics and lesson play layout		
Logistics and presentation and mediation capabilities of educator	.056	$p > 0.01$
	.017	$p < 0.05$
Logistics and integration of media in the lesson	.318	$p > 0.05$
Logistics and learner's performance		

5.4.11 RESEARCH PROBLEM 6:

Is there a significant difference in the average scores of teachers towards the following variables.

lesson plan layout

presentation and mediation capabilities of educator

integration of media in the lesson

learners' performance

logistics

H_{06}

There is no significant difference in the average scores of teachers towards the following variables.

H_6:

There is a significant difference in the average scores of teachers towards the following variables.

lesson plan layout

presentation and mediation capabilities of educator

integration of media in the lesson

learners' performance

logistics

The table (59) indicates the average scores of the variables of observation.

Table 59 Average scores of the variables of observation.

Variables	N	Mean
Lesson play layout	12	4.7500
Presentation and mediation capabilities of educator	12	4.5508
Integration of media in the lesson plan	12	4.5452
Learners' performance	12	4.3198
Logistics	12	4.7847

To correct for the fact that simultaneous comparisons (e.g. Bonferroni or Scheffe) couldn't be done, probability was divided by the number of equations (comparisons) which is 10. Data were not normally distributed so that the Wilcoxon Signed Ranks Test was used which is non-parametric test. The results appear in Table 60.

Table 60 Significance of differences of paired samples of observations

Pair	N	df	Mean
Lesson plan layout + integration of media into the lesson	-1.173	11	$p > 0.05$
Lesson plan layout + presentation and mediation capabilities of the educator	-1.52	11	$p > 0.05$
Lesson plan layout + learner's performance	-2.56	11	$p < 0.05$
Lesson plan layout + logistics			
Presentation and mediation capabilities of the educator + integration of media into the lesson	-3.52	11	$p > 0.05$
Presentation and mediation capabilities of the educator + learners' performance	-0.044	11	$p > 0.05$
Presentation and mediation capabilities of the educator + logistics	-2.28	11	$p > 0.05$
Presentation and mediation capabilities of the educator + logistics	-2.20	11	$p > 0.05$
Integration of media into the lesson + learner's performance	-1.51	11	$p > 0.05$
Integration of media into the lesson + learner's logistics	-1.87	11	$p > 0.05$
Learner's performance + logistics	-3.062	11	$p < 0.05$

The abovementioned tables indicate that:

(1) there is a significant difference (on the 5%-level of significance) between the average observation score for lesson plan layout and learner's performance - thus the null-hypothesis may be rejected which means that the average score

of lesson plan layout is significantly higher than the average score of learner's performance.

(2) there is a significant difference (on the 5%-level of significance) between the average observation score for learner's performance and logistics - thus the null-hypothesis may be rejected which means that the average score of logistics is significantly higher than the average score of learner's performance.

5.4.12 SUMMARY

All the previous chapters dealt with the literature study of this research work. The empirical study of this research was undertaken in this chapter. The chapter started with a description of the research sample. The sample consists of eight schools; four pre-primary schools and four primary schools. Each pre-primary school has ± hundred (100) learners. The total for the four pre-primary schools is ± four hundred (400) learners. Each of the four primary schools have ± 800 learners. The total for the four primary schools is ± 3200. Only one class from each of the eight schools took part in the study. They participated in the twelve (12) observation lessons presented by the educators. A five point lesson observation guide was used to capture data during the presentation of lessons. The following points were taken into consideration:

(a) The lesson plan layout

(b) Presentation and mediation capabilities of the educator

(c) Integration of media in the lesson

(d) Learner performance

(e) Logistics

Although observation seem to be a straight-forward technique, it must be pursued in a systematic way following laid out rules, if quantifiable data have to be obtained (Bless & Higson-Smith 1995:105). The observation that was carried out clearly formulated research purposes, it was recorded in a systematic, objective and standardized manner. The researcher recorded the same events as stipulated in the observation guide. (Please refer to Annexure "B").

The foregoing was succeeded by a discussion of the questionnaire construction techniques. The distinction among the three types of questions such as open-ended questions, close-ended questions, and contingency questions (De Vos 1998:299) were discussed. The researcher used close-ended questions to structure the questionnaire because they do not require the respondent to write anything. Close-ended questions can help the researcher to tap as much information as possible from the respondents. Their analysis is straight-forward and they do not call for motivation from the researcher to get the respondent to respond to the questions posed. The researcher gave full attention to the wording of the questions.

The researcher tried to avoid complex questions and went for simple and short questions. The researcher avoided ambiguous questions and used vocabulary adapted to the level of education of the respondents. (Please refer to Annexure "A"). The questionnaire was subjected to a Pilot Study and the results indicated that the questionnaire wording and phrasing was appropriate to the respondents.

Data were gleaned by means of a questionnaire completed by seventy (70) educators. The questionnaire was designed to gather data on the following:

(a) Possible effects of media in the teaching of mathematics lessons

(b) Media selection

(c) Integration of media in Mathematics lessons and

(d) The availability of media in schools.

The discussion of data collection was followed by the data analysis and interpretation. The statistical techniques were used to put the researcher in a position to either reject or accept the null hypothesis. The techniques used were Wilcoxon Signed Ranks Test, The Pearson Correlation coefficient, the NPar Test and Friedman Test.

On the basis of the findings as stated earlier in Research Problems 1 to Research Problem 6 the researcher has sufficient, concrete evidence to conclude that the results invalidate the null hypothesis tested. Therefore the researcher's conclusion is that:

(a) there is possible effect of media in the teaching of mathematics lessons and media selection

(b) there is possible effect of media selection and integration of media in mathematics lessons.

CHAPTER 6

6. FINDINGS, CONCLUSIONS, RECOMMENDATIONS, IMPLICATIONS OF THE RECOMMENDATIONS, SUGGESTIONS FOR FUTURE RESEARCH AND CONCLUDING REMARKS

6.1 INTRODUCTION

The fundamental purpose of this research is to establish whether mathematics can be taught effectively with the use of appropriate media and to further establish the possible effects of media in the teaching of mathematics and media selection. The problem has been probed in-depth in the previous chapters.

The aim of this chapter is to give a synopsis of the research undertaken and to round it off. It is therefore imperative to recapitulate on the statement of the problem, demarcation of the field study, aims of the investigation and methods of research.

The discussion of the foregoing will be succeeded by a discussion of the main findings derived from both the literature study and the empirical research undertaken. This will be succeeded by the conclusions drawn from this investigation. Thereafter the recommendations arising from the findings, the implications of the recommendations and suggestions for future research related to this one will be presented. The researcher will conclude this study with a few remarks.

The primary purpose of this study is to establish the significant effects of media integration in the teaching of mathematics lessons in the Pre-primary and Primary schools. The research problem can be stated in specific terms to capture the following:

(a) factors that influence the learners' cognitive development

(b) the criteria used by educators in the Pre-primary and Primary schools media for use in mathematics lessons.

(c) the impart that the following factors have on media selection:

1. specific outcomes
2. learner variables and interest
3. learning environment and
4. the educator's capabilities

(d) attempts that are being made by educators in effecting media integration in teaching mathematics in pre-primary and primary schools.

6.2 The method of research

The research method in this study can be divided into a literature study and an empirical investigation. The literature study was done with a view to support the introductory orientation of this study. A questionnaire was used to gather information and views of educators about the integration of media in the teaching of mathematics in the pre-primary and primary schools. An observation guide was also used during the observation of presentation of lessons by eight (8) educators. The lessons included the nature and characteristics of media employed in the lessons. The following factors were taken into account:

specific outcomes

content accuracy and relevance

learner variables and interest

the learning environment and

the mediation capabilities of the educator

The questionnaire was intended to gather data from seventy (70) educators and that include eight (8) educators who presented the twelve (12) lessons. It was on the basis of the empirical study that the null hypothesis was rejected.

6.3 FINDINGS FROM THE STUDY OF LITERATURE

The literature study of this research first focussed on learning as an active process, it also highlighted how young learners acquire knowledge and how their interaction with their environment impacts on their cognitive development (Papalia et al 1988:159). The research also dealt with concept formation with special reference to the variety of concepts such as physical sensory concepts, action-function concepts, evaluative concepts and abstract concepts (Tomlinson 1981:68; Baldwin et al 1970:30).

Literature reveals that learning is a change of behaviour and that when learning has taken place the results of learning are observable (Ausubel, Novak and Hanesian (Tomlinson 1981:125). When learning has taken place the learner is able to do something or has knowledge of something that he/she could not do before or something that he/she did not know before (Van Aswegen 1979:53).

Researchers agree that it is possible to distinguish among different types of learning since learning occurs in a variety of ways. A distinction is made between rote learning and meaningful learning. Literature points to the fact that meaningful learning, unlike rote learning which is based on memorization without understanding, makes the learning process effective by affecting it at all the three main phases, that is, acquisition, retention and retrieval. This is an indication that educators must dwell more on meaningful learning (Ausubel et al in Tomlinson 1981:125).

Motivational learning is undoubtedly based on the learner's resolve or intention to put in some effort to perform a learning task (Keeves 1986:135). Personal contact or a climate that emphasizes positive interactions between the educator and the learner leads to building self-esteem in learners. Literature reveals that the educator needs to make sure that learners are actively involved in any lesson presented to them. The educator should motivate the learners by showing some amount of interest, enthusiasm and zeal for all the lessons he/she presents and by using relevant media to capture the learners attention (Kruger et al 1983:104). The educator should know that where there is interest, attention takes place and where there is attention, meaningful learning takes place (Schultz et al 1987:433; Levine 1988:23; Amudson 1991b:1-3).

It has been observed that most learners base their learning on imitation of models. This type of observational learning is very common among young learners. Young learners normally observe and try out certain behaviour or action of the observed (Hughes et al 1967:112). Educators can take advantage of this type of learning by displaying acceptable behaviour in front

of young learners. There are other types of learning mentioned in chapter two of this study such as concept learning and cognitive learning.

Concept learning has to do with learning objects on the basis of their similarity or commonality. For any concept to be successfully learned, the learner has to be aware of its features, its attributes and its value (Papalia et al 1988:160). All these features affects their difficulty in learning. Some concepts that are abstract can be explained by verbal definition, like in the case of happiness, truth, love and so forth whereas concrete concepts can be explained in terms of size, weight, shape, colour and many concrete features.

Cognitive learning has to do with learning facts as well as their interrelations. The essential element in acquisition of factual knowledge is the assimilation of what has been learned. The educator can discover by means of a test that his learners have or do not have knowledge of a given subject. It has been found out that people often learn things with no obvious or willful intention to do so (Jordaan et al 1975:643-644). Some learn things intentionally but without any great effort and still on other occasions it seems that one has to work hard in order to memorize needed material. In incidental learning, material is learned unintentionally. There are no set rules to follow for learning to take place.

In Piaget cognitive development theory, the findings is that Piaget's theory is oriented neither to the emergence of genetic potential nor to learning but centres on the interaction between the learner and his/her environment (Berk 1991:22). The interaction involves what Piaget terms, assimilation, accommodation and equilibration (Krech et al 1982:365). All these concepts

portrayed by Piaget indicate that there is continuous mental growth and development that helps the child to adapt to his environment (Piaget in Copeland 1984:405).

Chapter two also touched on the cognitive functioning of the young learner. The development of number concept was highlighted that young learners exposed to efficient counting procedure are likely to discover or construct number concepts.

Other features that stand out clearly with number systems are concepts such as ordering, comparing, seriation, number conservation and classification. These features play an important role in the young learners number concept formation in relation to his/her world (Clark-Stewart 1985:25).

Apart from the view expressed by Piaget's (Copeland 1984:405) about cognitive development, Bruner (Tomlinson 1981:202) postulated progression stages from inactive to iconic and further to the symbolic were discussed and the findings indicate that the inactive stage corresponds to Piaget's sensory motor stage where things are known only in terms of one's action to them. The iconic corresponds to pre-operational stage where concretization is established and of course the symbolic stages corresponds to Piaget's concrete operations (Spodek 1985:113).

Bruner advocates a guided discovery process to deal with concept development. Bruner, like Piaget postulates that his stages are partly the result of interaction and adaptation with the environment (Spodek 1985:113).

Other recent models of intelligence were discussed, such as Sternberg's view of cognitive development, Gardner's view of cognitive development, Feuerstein's approach to cognitive development as well as Carl Haywood's approach to cognitive development. All in all, one can conclude that the emphasis is on helping the learner to understand and to make sense of the learning material by engaging him in the act of learning how to think systematically rather than what to think. All that could be attained through the educators' mediation, intervention as well as motivation.

Chapter three of this thesis dealt with the various methods which could be used in conjunction with media in lesson presentation. Methods such as presentation method, which is a one-way communication controlled by the source such as reading a book, viewing a film, listening to a tape, were discussed. The findings are that the method reduces the learner to a passive listener (Mbambisa et al 1990:25; Kruger et al 1983:102). Demonstration method enables the educator to explain certain concepts by means of demonstration. Demonstration is aimed at the formation of mental images of what has been demonstrated (Van der Stoep in Kruger et al 1983:114).

Drill and Practice method is one other method that can be used in conjunction with media. Certain media from certain media formats and delivery systems lend themselves particularly well to learners' drill and practice exercises. The findings are that young learners do not tire from repeating, which is in actual fact, practice of the process. Gaming method adds motivation to topics that attract young learners' interest (Heinich et al 1990:334). Gaming provides a playful environment in which learners follow rules as they strive to attain a challenging goal (Gerlach et al 1971:340). The findings are that for gaming to

be effective the educator must define learning objectives and what the learners' will do after having played the game that they could not do before (Brown et al 1977:301).

Simulation method as in gaming method has instructional objectives. In simulation there is no winner. The results of simulation are observable changed conditions. The findings are that the educator's responsibility in simulation or gaming is to assess the readiness of learners to participate in and succeed with any activity selected. Discovery method uses inductive or an inquiry approach to learning. The aim is to foster deeper understanding of the content through involvement with it. Findings are that the educator can set up self-activity learning processes for his learners in the form of written assignments and projects (Kruger et al 1983:107).

Various instructional media have been described in chapter three of this study. Media such as visuals and pictorial representations, non-projected visuals such as models, field trips, realias, illustrations, charts and diagrams, chalkboards, multipurpose boards, graphs and cartoons. The study also touched on projected visuals such as overhead projectors, slides and filmstrips. Other forms of media discussed are audio media, their characteristics and the types of audio media available in the market. Some of the above mentioned media are available in some schools. Other schools do not have resources, they rely on improvised learning/teaching material.

Chapter three also touched on technology in education. That technology is essential in the teaching and learning of mathematical concepts (National Council of Teachers of Mathematics (NCTM) 2000:11). Institutions of

educator learning and training are challenged with the task of empowering educators to be in a position to utilize technology as an essential tool for developing a deep understanding of mathematics (Drier 2001:170).

Computer-based instruction was also discussed. The computers are seen as media that can provide learners with individualized attention which frees the educator to concentrate on slow learners and/or gifted learners. There are two types of computer-based instructions, they are, computer-assisted instruction (CAI) and computer-managed instruction (CMI) (Anderson 1976:126). In the (CAI) the computer stores the instructional material and controls the sequence, whereas in the (CMI) the computer helps the educator/instructor to administer and guide the instructional process (Brown et al 1977:23). Computers are very expensive as such most schools cannot afford to buy them.

The other medium discussed is the compact disc. This medium has been found to improve the learner's learning and understanding. The unfortunate part is that it is expensive and not readily available in some schools, due to lack of funds.

The centres for young learners to learn mathematical concepts were discussed. The following centres stated below were found suitable for the teaching of young learners. The research touched on house-living centre, block-building centre, art centre and fantacy centre. It is in these centres that the young learners have an opportunity to express themselves and to learn mathematics concepts (Faber et al 1997:113).

In classroom learning, media such as calculators, rulers, dictionaries, textbooks and reading books, workbooks, atlases, models and real object were discussed. It is clear that the need to have appropriate media in all schools cannot be over-emphasized. Media as carriers of information from a source to a receiver play an important role in helping to impart knowledge to the learners and to achieve the desired outcomes.

The first thing to consider when selecting media is the learners' analysis. Four factors that would inform the educator about his learners are: demographics, motivation to learn, ability to learn and learners' background. These will determine the type of media and the most appropriate method of presentation. The educator should always ascertain if all, or at least a high percentage of learners are ready for the media she/he intends to utilize

Learners' characteristics are the next to be considered. For example, learners with low reading skills may be reached out more effectively with concrete media. When dealing with learners of a particular ethnic or a cultural sub-group it might be wise to be sensitive to the cultural identify, in selecting particular learning material.

Instructional objectives are intended outcomes rather than the process of instruction. Meaningful objectives start by referring to what learners are to achieve after an instruction. For an objective to demonstrate an intent, the following characteristics should be taken into consideration: learners' performances, learners' behaviour, conditions of occurrence and degree or criterion (Steyn 1991:69).

The general principles and guidelines for media selection were discussed in chapter four of this study. The objectives of the material must match that of the educator; there is no media that can serve all purposes; media must be appropriate for the mode of instruction; media must be chosen objectively rather than on the basis of personal preference and lastly, media effectiveness is dependent on suitable physical conditions surrounding it. The findings are that most educators believe that different criteria are suitable for different situations. What stands out clear is that all kinds of media are subject to these guidelines.

Most educators prefer to produce their own teaching material. Certain basic considerations must be taken into account such as, the objectives of the lesson, target learners, current content and its suitability, cost effectiveness of the material, appropriateness of the material to communicate intended objectives, and lastly, the technical touch to determine whether the material is technically satisfactory.

Media used in conjunction with the suitable or appropriate method should help to actualize what is expected from the learner. Material must be previewed in advance to determine its suitability; presentation him/her to face up to the learners probing questions; preparation of the learning environment; the physical and psychological conditions in his/her classroom may well determine his/her success or failure; preparation of learners, it is proper to prepare the learners about the presentation that has to be made by making it clear why such material is being used; actual presentation, this is the time to show the skill of presentation by moving with learners; and capturing their interest and attention, and lastly is the follow up activities, those activities help the educator

to assess if stated objectives have been met. It is clear that the most important point to be remembered by the educator, is that the lesson should never end abruptly after the presentation and mastery of the learning content.

6.4 FINDINGS FROM THE EMPIRICAL RESEARCH BASED ON THE QUESTIONNAIRE

The following is a succint summation of the main findings which emerged from the empirical research..

Research Problem 1

A majority of the educators definitely agree that:

1. mathematics can be taught effectively with the use of appropriate media.
2. properly designed educational media can enhance and promote learning.
3. learners perform better when lessons are accompanied by instructional media.
4. the effective use of instructional media can tap the powerful and undeveloped potential of the learner.
5. some educators feel confident when using instructional media in teaching mathematics.
6. there must be a match between the characteristics of the learner and media to enable good selection of media to be effected.
7. there must be a match between the content of the lesson and its presentation method.
8. selection of relevant and appropriate media for teaching mathematics always yields good performance results.

9. the socio-economic factors help to determine the level of the lesson and the media to be utilized to make learning meaningful to the learners.
10. age determines media to be utilized to make learning meaningful to the learner.
11. the level of development of the learners determines media to be utilized to make learning meaningful to them.
12. they always allow their learners to experience the utilization of educational media.
13. not many of them keep media utilization inventories to measure the frequency of media usage.
14. some of them preview the educational media well in advance of formal presentation.
15. they must know their learners in order to select the best medium to meet specific outcomes.
16. they would like to be exposed to the criteria for making appropriate selection of media for use in mathematical lessons.
17. they prefer to design their own educational media to serve their learners precisely and to meet specific outcomes.
18. not many of them have been exposed to media integrated learning during their school years.
19. not many of them have resource rooms in their schools.
20. some of them know how to operate educational media available at their schools.
20. some of them claim that there are enough instructional media in their schools to meet a variety of specific outcomes.

21. a majority of the educators disagree that the instructional media for teaching mathematics in their schools are in a working condition.
23. some educators do sometimes discuss the availability of media in their schools with their principals.

Research Problem 2

The correlation between media variables and their significances:

1. Media availability in schools correlate negatively with possible effects of media in the teaching of mathematics lesson and media selection. Not many schools as indicated in the research have enough appropriate media for use in the teaching of mathematics lessons.
2. None availabililty of media in school impacts negatively on media selection.
3. Integration of media in mathematics lessons correlates positively with possible effects of media in the teaching of mathematics lessons (low correlation) and media selection (moderate correlation). These correlations are significant on the 1%-level of significance, this means that the null hypothesis may be rejected and as the one variable increases, the other variable also increases (and vice versa).

Research Problem 3

Significance of differences in average scores

There is an indication that all averages differ significantly from one another so that the null hypothesis may be rejected. These differences are all on the 1%-level except for the significance of the possible effect of media in the teaching of mathematics lessons and media selection. This difference is on the 5%-level of significance.

6.5 FINDINGS FROM THE EMPIRICAL RESEARCH BASED ON OBSERVATION LESSONS PRESENTATIONS

Research Problem 4

The observations of educators regarding the use of media for teaching mathematics. Twelve (12) lessons were observed and an observation guide was used for recording.

The following are the findings based on the observation:

(a) Lesson plan layout

27 83.3 percent (excellent) indicated that the topic of the lesson was relevant.

28 75 percent (excellent) that the intended outcomes were clearly stated

(b) Presentation and mediation capabilities of the educator

29 66.7 percent (excellent) indicated that the educator did link the lesson to the learners' previous knowledge.

30 58.3 percent (excellent) that the educator used skilful questioning to encourage the learners to think and use knowledge already acquired.

31 100 percent (excellent) indicated that the educator had sufficient knowledge about the content of the lesson.

32 75 percent (excellent) indicated that the educator had organised the content meaningfully.

33 75 percent (excellent) indicated that the educator knew exactly what he/she wanted to teach.

34 66.7 percent (excellent) indicated that the educator used good oral instructions to set the scene and to explain tasks to the learners.

35 66.7 percent (excellent) indicated that the educator integrated media in the lesson he/she presented.

36 50 percent (excellent) indicated that the educator managed to get the learners to participate in the lesson.

37 58.3 percent (well done) indicated that the educator used praise and motivation.

38 50 percent (excellent) indicated that the educator managed to notice learners who needed extra support.

39 50 percent (excellent) indicated that the educator used continuous assessment as an aid to the learning process.

(c) Integration of media in the lesson

40 58.3 percent (excellent) indicated that the observer was satisfied about the quality of media that was used.

41 58.3 percent (excellent) indicated that the observer was satisfied about the appropriateness of the media that was used.

42 66.7 percent (excellent) indicated that media did help to arouse the learners' interest.

43 50 percent (excellent) indicated that the educator did use media to sustain learners' interest.

44 50 percent (excellent) indicated that media did help to promote participation of learners in the lesson.

45 33.3 percent (excellent) indicated that there was evidence of effectiveness of media in the lesson.

46 A tie of 41.7 percent (both excellent and well done) indicated that media used was cost effective in terms of learners' achievement.

47 58.3 percent (excellent) indicate that the learners did enjoy the lesson.

48 41.7 percent (excellent) indicated that the learners participated in groups and pairs.

49 66.7 percent (excellent) indicated that the learners found the educator's explanations clear.

50 41.7 percent (excellent) indicated that the learners found the activities meaningful.

51 41.7 percent (excellent) indicated that the learners new what the educator expected of them.

52 50 percent (excellent) indicated that the learners' performance was constructive.

53 41.7 percent (excellent) indicated that the learners did learn something from the lesson that was presented.

54 83.3 percent (excellent) indicated that there were enough desks for the learners.

55 83.3 percent (excellent) indicated that there was enough light in the classroom.

56 66.7 percent (excellent) indicated that media were enough for the learners.

57 66.7 percent (excellent) indicated that the lesson was completed to the satisfaction of both the learners and the educator.

RESEARCH PROBLEMS 5 & 6

1. The findings for these questions are that there is a significant difference (on the 5%-level of significance) between the average score for lesson plan layout and learner's performance - thus the null hypothesis may be rejected which means that the average score of lesson plan layout is significantly higher than average score of learner's performance.

2. The findings also indicate that there is a significant difference (on the 5%-level of significance) between the average observation score for learner's performance and logistics - thus the null-hypothesis may be rejected which means that the average score of logistics is significantly higher than the average score of learner's performance.

6.6 CONCLUSIONS

Within the limits of this research and from evidence presented the following conclusions can be drawn:

There is a general consensus that effective instructional media can help the learners understand the massive changes in their world. Media can only be effective if it is appropriate and relevant to serve the purpose of its usage. Factors that need to be considered when selecting media are, among others, correctly stated objectives of the lesson and the learners' learning goals. The objectives have to do with the new capabilities that the learner should possess at the completion of the lesson. Objectives provide the educator with concrete help and direction. Once the educator has succeeded in determining the actual learning needs of the learners, these needs should be described in terms of instructional objectives which the educator uses.

Other factors that have to be considered in media selection are the characteristics of the learner, the size and composition of the group to be taught. Analysing learners can be easy for a teacher who has been with the learners for a reasonable time, if that is not the case, the use of academic records for older learners would suffice, but for young learners, the educator can place the learners according to their age and level of development.

The above can be made possible if educators have true commitment to significantly apply the principles stated concerning media selection. The successful completion of any lesson at all, is largely dependent on the effectiveness of the educator.

The findings from the empirical research reveals evidence that there is a positive role played by media in the teaching of mathematics lessons in the pre-primary and primary schools.

6.7 RECOMMENDATIONS

1. Educators should be encouraged to read and understand the various psychological theorists views and approaches to cognitive development of learners because this forms the foundation for knowing and understanding the human mind and how the learners interact with the world around them.

2. The learner must be helped to understand his world. This mean that the learning content must be life oriented and must assist the learner in understanding and living his/her world meaningfully. At the same time, the educator who is keen to conduct himself in a truly professional manner must be prepared to face the challenge of transformation that is characterized by bewildering technological developments.

3. Each school should have a resource centre where a variety of media is kept. In such a centre there must be a trained resource person. Materials must be catalogued as in the library so that both learners and

educators can easily access information and material to be used. Resource-based learning enable the educator to set a stage for discovery. The educator can skilfully set the learners to discover what they want to learn about the things they need to know. A resource centre introduces the learners to the wealth of resources and inspires them to search for more knowledge.

4. The educator is expected to display initiative, drive, adaptability, knowledge, deligence and a high degree of professionalism. He/she must continuously review his/her classroom practices and make sure that he/she has relevant media for use in the lessons that he/she presents.

5. The educator must make sure that the classroom provides a true educational environment where learners will learn consciously and unconsciously. It should have on its shelves and walls a variety of media. Such an environment will stimulate the learners' interest and attention to learn and to make sense of what they see around them.

6. Motivation plays an important role in the education of the learner. Each school should encourage its educators to give serious consideration to motivation of learners. Motivation of learners help to build the learners' self-esteem, boosts their morale and thus make them feel positive about the school and their academic performance.

7. Mathematics is one of the most important learning areas. This fact is recognized by the Department of Education. Most educators are

knowledgeable about mathematical concepts and they can impart that knowledge but to most of them, the idea of understanding as the main goal, may have played little part in their mathematics education. There is need for educators to be workshopped on the right methods of presentation of mathematic concepts in order to avoid drill and rote learning.

8. The Department of Education must introduce technology in education as one of the learning areas in schools. Technology is essential in teaching and learning mathematics. Higher institutions for teacher education and training are charged and challenged with task of preparing educators who can fully utilize technology as an essential tool for developing a deep understanding of mathematics.

9. The Department of Education should supply schools with computers to encourage computer-based instruction. In computer assisted instruction, the instructional material is stored and the computer controls its sequence, making it easy for the learner to interact directly with it.

10. Selection of media should always be discussed with the head of the school, so that he/she can appreciate the need to buy (if funds are available) or to find other means of acquiring media for his/her school.

11. The educator must make it a point to review the material beforehand and to prepare the learners about the presentation that has to be

made. For young learners all they need is a stimulating introduction which would arouse their interest and attention.

12. The educator must help the young learners to discover basic mathematical concepts in everyday experiences by providing them with media such as building blocks, water play, "shopping" etc. To a large extent the young learners attitude toward mathematics is formed in the early childhood years. It is the educator's work to make it possible for the learners to discover the mathematical environment.

13. Educators must be exposed to the principles and guideline of media selection and should be encouraged to integrate media in the teaching of mathematics lessons. Media are tools for helping the learner to understand what is being taught.

14. The educators must be exposed to the various theories of education with special reference to views and approaches of cognitive development and cognitive functioning of the young learner, so that he/she can be aware of how the learner interacts with his/her world.

15. Educators should be encouraged to upgrade themselves by attending workshops and seminars on learning areas relevant to their work. They should perform their duties as required and portray a real sense of commitment in what is expected of them.

16. The educators must be exposed to the skills of lesson presentation and the integration of media in the lessons to be taught. Demonstration lessons should be encouraged among peer educators.

6.8 IMPLICATIONS OF THE RECOMMENDATIONS

Educators should weigh up and combine the contributions of various psychological theorists' viewpoints in an open-minded but critical approach and not simply adopt one theory because it happens to appeal to his/her intuitive notions.

In teaching and learning, the cognitive processes involved in perceiving, understanding, thinking are of great importance. Knowledge and understanding and the capacity to work things out are important goals of teaching. The educator can achieve these goals by engaging learners in activities that include explaining, showing, illustrating, probing and so forth. All these can be possible and effective if the educator integrate media in his/her lessons.

For each school to have a resource centre, it might proof to be expensive, more especially that most schools do not have means of generating funds. The implication is that the Department of Education should operate a resource centre which would serve all the schools within a neighbourhood. Preferably it should be nearer or share the same building with the Educator's Centre. The educator, with the help of the resource personnel will be able to access media relevant and appropriate to the lesson he/she intends to teach.

The Department of Education must mount workshops for teachers to be exposed to the need for media integration in their lessons. They should be guided in the principles of media selection and in the production of their own media..

It is clear as indicated above that there is need for educators to be exposed to knowledge of how to select appropriate media for their lessons and how to effectively integrate media and methods to obtain desired learning outcomes in mathematics. However as indicated in chapter one, the usage of a variety of media or having good stock of media in your school, does not necessarily mean that your teaching will yield good results. Effectiveness depends on the correct use of those media most conducive for the attainment of specific objectives of the lesson.

A variety of methods which could be integrated with media for presentation of lessons were discussed. Types of learning such as meaningful learning motivational learning, association learning, concept learning and cognitive learning were discussed. All in all, learning could be defined as a process whereby capacities or tendencies change as a result of action or experience.

It could also be said to be a change of behaviour, that when learning has taken place, the results of that which has been learned are observable.

The fundamental aim of this study is to establish beyond doubt the effect of media integration in the teaching of mathematics in the pre-primary and primary schools. The objectives are to investigate the factors that influence the learners cognitive development and how these impact on media selection

and also to establish the attempts that are being made by educators in integrating media in the teaching of mathematics in the pre-primary and primary schools.

The above were discussed at length in chapter two touching on Piagetian view of cognitive development. Piagets general developmental principles such as equilibration, assimilation, and accommodation were discussed. All concepts portrayed by Piaget indicate that there is a continuous mental growth and development that helps the child to adapt to his environment. Piaget suggest four major stages in development and that each stage represents a discrete and qualitative step upwards from the preceding one. Apart from Piagets view, the researcher touched on Bruner's view of cognitive development and the views of other recent psychologists such as Sternberg. Sternberg's information theory approach features meta-cognition, that is, the ability that an individual has to have in order to be in touch with his mental abilities. That, that knowledge would afford him greater cognitive benefits than when he/she is blank or out of touch. Gardner's view of cognitive development was also discussed. His theory of multiple intelligence emphasizes the view that the mind is organized in terms of relatively independent realms of functioning.

This research study also touched on Feuerstein's approach to cognitive development. Feuerstein believes that the high forms of human cognitive development are the results of learning which is mediated by human intervention for example, according to his theory, a child who is highly challenged needs an adult intervener who will offer him/her a purposeful direction. Lastly, Carl Haywood's approach to cognitive development was

discussed. His emphasis is on learner-centred approach. He postulates that learners should not be taught what to think, but rather, they must be helped to learn how to think effectively and systematically.

Various methods that can be used in conjunctional instructional media were discussed. Various instructional media available in most schools were mentioned in the whole of chapter three covered a wide range of types of media suitable for all ages. Emphasis was on projected and non-projected visual media as well as audio media.

Chapter five dealt with the empirical investigation. The description of the procedure followed in the collection of data was discussed. Data was subjected to a statistical analysis and calculations. The findings from the empirical research of this study provide the researcher with substantial evidence to reject the null hypothesis postulated in this study. There is abundant proof that there is a positive effective in media integration in the teaching of Mathematics in the pre-primary and primary schools. The conclusions reached in the empirical study are in line with the conclusion reached in the literature study thus proving that they are beyond all reasonable doubt.

6.9 SUGGESTIONS FOR FUTURE RESEARCH

Since mathematics and the integration of media in teaching mathematics lessons are of vital importance in contemporary education and also taking account of dearth of empirical research in this study, the following topics are suggested for future research:

1. The impact of media on the cognitive styles and personalities of learners.
2. The development of teaching skills and social strategies with special reference to media selection.
3. The need for mathematics educators to fully utilize media in mathematics lessons and to view the growth of cognitive connections.

6.10 CONCLUDING REMARKS

This research focussed on the media integration in the teaching of mathematics in the pre-primary and primary schools. It was postulated at the beginning of this research that teaching and learning can only be successful if the educator employs instructional approaches that would engage and sustain the learners' interest and attention, and encourage them to be active participants in the learning situation. The above could be achieved through the utilization of media in lesson presentations.

Media can be effective if the educator employs the principles and guidelines for media selection. The previous chapters emphasized the need for the following factors to be considered in the selection of media:

(a) Correctly stated objectives of the lesson and the learner's learning goals.

(b) The characteristics of the learner, the size and composition of the group to be taught.

(c) The learners performance.

Teacher educators have long emphasized the importance of lesson preparation, but this has usually referred to subject-matter content. However,

content should also be planned in terms of psychological aspects such as the concepts involved, their difficulty, the experience and ability of the receiving learners and so forth. This should be combined with planning for other psychological aspects such as teaching techniques, control and motivation strategies, as well as appropriate media that would be used as a tool for conveying what has to be taught on the importance of media and the variety of media available in both the schools and the resource centres. They should be informed about the principles and guidelines of media selection.

In-Service education run by the school and in-service education manned by the Department of Education should be made compulsory for all educators, especially those engaged in teaching mathematics. The educators should be exposed to suitable methods and appropriate media for integration in the teaching of mathematics in the pre-primary and primary schools, because mathematics open doors to the world of Science and Technology.

The principal and heads of departments must perform their supervisory duties to make sure that educators apply the knowledge they acquired at the workshops mounted by the Department of Education. Class visits are a must in achieving that goal.

Higher institutions for teacher education and training should expose learner educators to the principles and guidelines for media selection. This could be achieved by structured and supervised demonstration lessons and lesson observation.

The researcher is optimistic that the findings, recommendations and guidelines embodied in this research could provide invaluable assistance to serving teachers and teachers in making. Going through all the chapters of this research, the reader will gather as much information that would trigger within him/her the need for further investigation in the utilization of media in lesson presentations.

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ANNEXURE "A"

INSTRUCTIONS FOR COMPLETING THE QUESTIONNAIRE

Please read the following instructions carefully:

1. Choose the number which is close to your own views.
2. Ring the number.
3. The choice of (5) implies that you are in total agreement with the statement.
4. The choice of (1) implies that you disagree with the statement.
5. If you are not sure, then you would choose a number between 1 and 5 which leans slightly to your own views.

THE QUESTIONNAIRE

PARTICULARS OF THE RESPONDENT

Name of School : .....

Town/Village : .....

Pre-primary/Primary School: .....

GENERAL VIEWS		Definitely Disagree				Definitely Agree	
(a)	**Possible effects of media in the teaching of mathematics lessons**						
1.	Mathematics can be taught effectively with the use of appropriate media.	1	2	3	4	5	V1
2.	Properly designed educational media can enhance and promote learning.	1	2	3	4	5	V2
3.	Learners perform better when lessons are accompanied by instructional media.	1	2	3	4	5	V3
4.	The effective use of instructional media must tap the powerful and undeveloped potential of the learner.	6	5	4	3	2	V4
5.	Some teachers always feel confident when using instructional media in teaching mathematics..	6	5	4	3	2	V5
(b)	**Media Selection**	(Please ring where possible)0					
1.	There must be a match between the characteristics of the learner and media.	1	2	3	4	5	V6
2.	There must be a match between the content of the lesson and its presentation method.	1	2	3	4	5	V7
3.	Good selection of relevant and appropriate media for teaching mathematics always yields good performance results.	1	2	3	4	5	V8
4.	Socio-economic factors help to determine the level of the lesson and the media to be utilized to make learning meaningful to the learner.	1	2	3	4	5	V9
NB:	**The rating goes as far as 5. Please ignore V1 to V9 when completing the form.**						

		Definitely Disagree			Definitely Agree		
5.	Age determines media to be utilized to make learning meaningful to the learner.	1	2	3	4	5	V10
6.	Level of development of the learner determines media to be utilized to make learning meaningful to the learner.	1	2	3	4	5	V11
		(Please ring where possible)					
PERSONAL VIEWS							
(a)	**Integration of media in mathematics lessons**						
1.	I always allow my learners to experience the utilization of educational media.	1	2	3	4	5	V12
2.	I keep media utilization inventories to measure the frequency of my use of media.	1	2	3	4	5	V13
3.	I always preview the educational media well in advance of formal presentation.	1	2	3	4	5	V14
4.	I must know my learners in order to select the best medium to meet the specific outcomes.	1	2	3	4	5	V15
5.	I would like to be exposed to the criteria for making appropriate selection of media for use in Mathematics lessons.	1	2	3	4	5	V16
6.	I prefer to design my own educational media to serve my learners precisely and to meet the specific outcomes.	1	2	3	4	5	V17
7.	I have been exposed to media integrated learning during my school years.	1	2	3	4	5	V18
(b)	**Availability of media in my schools**	**(Please ring where possible)**					
1.	My school has a resource room.	1	2	3	4	5	V19
2.	I know how to operate educational media available in my school.	1	2	3	4	5	V20
NB:	**The rating goes as far as 5. Please ignore V10 to V20 when completing the form.**						

		Definitely Disagree			Definitely Agree		
3.	There are enough instructional media in my school to meet a variety of specific outcomes.	1	2	3	4	5	V21
4.	The instructional media for teaching mathematics in my school is in working condition.	1	2	3	4	5	V22
5.	I sometimes discuss the availability of media in my school with my principal.	1	2	3	4	5	V23
NB:	**The rating goes as far as 5. Please ignore V21 to V23 when completing the form.**						

ANNEXURE "B"

INSTRUCTIONS FOR COMPLETING THE OBSERVATION GUIDE

1. Sit-in when the lesson is being presented.
2. Note your observations.
3. Refer to the evaluation instrument and choose the appropriate number which is close to your views on the five-point-scale.
4. Ring the number.
5. The choice of (5) implies that the item was excellently handled.
6. The choice of (1) implies that the item was poorly handled.
7. If you are not sure, then you would choose a number between 5 and 1 which leans slightly to your views.

LESSON OBSERVATION FORM

Name of School : .....

Town/Village : .....

Pre-Primary/Primary School: .....

Name of he teacher : .....

Male/Female : .....

Number of learners : .....

(a) Females : .....

(b) Males : .....

(a)	**LESSON PLAN LAYOUT**	**Poor**			**Excellent**		
1.	Was the topic of the lesson relevant?	1	2	3	4	5	V1
2.	Were the intended outcomes clearly stated?	1	2	3	4	5	V2
(b)	**PRESENTATION AND MEDIATION CAPABILITIES OF THE EDUCATOR**						
1.	Did the educator link the lesson to the learners' previous knowledge?	1	2	3	4	5	V3
2.	Did the educator use skilful questioning to encourage learners to think and use knowledge already acquired?	1	2	3	4	5	V4
3.	Did the educator have sufficient knowledge about the content of the lesson?	1	2	3	4	5	V5
NB:	**Rating goes as far as 5. Please ignore V1 to V5 when completing the form.**						
		Poor			**Excellent**		

4.	Did the educator organise the content meaningfully?	1	2	3	4	5	V6
5.	Did the educator know exactly what he/she wanted to teach?	1	2	3	4	5	V7
6.	Did the educator use good oral instructions to set the scene and to explain tasks to the learners?	1	2	3	4	5	V8
7.	Did the educator integrate media in the lesson she/he presented?	1	2	3	4	5	V9
8.	Did the educator manage to get the learners to participate in the lesson?	1	2	3	4	5	V10
9.	Did the educator use praise and motivation?	1	2	3	4	5	V11
10.	Did the educator notice learners who needed extra support?	1	2	3	4	5	V12
11.	Did the educator use continuous assessment as an aid to the learning process?	1	2	3	4	5	V13
(c)	**INTEGRATION OF MEDIA IN THE LESSON**						
1.	What was the quality of media used?	1	2	3	4	5	V14
2.	Was the media appropriate?	1	2	3	4	5	V15
3.	Did the media help to arouse learners interest?	1	2	3	4	5	V16
4.	Did the educator use media to sustain learners interest?	1	2	3	4	5	V17
5.	Did media help to promote participation of learners in the lesson?	1	2	3	4	5	V18
6.	Was there evidence of effectiveness of media in the lesson?	1	2	3	4	5	V19
7.	Was the media used cost effective in terms of learners' achievement?	1	2	3	4	5	V20
NB:	**Rating goes as far as 5. Please ignore V6 to V20 when completing the form.**						

		Poor			Excellent		
(d)	**LEARNERS' PERFORMANCE** (Ring number)						
1.	Did the learners enjoy the lesson?	1	2	3	4	5	V21
2.	Did the learners participate in groups or pairs?	1	2	3	4	5	V22
3.	Did the learners find the explanations clear?	1	2	3	4	5	V23
4.	Did the learners find the activities meaningful?	1	2	3	4	5	V24
5.	Did the learners know what the educator expected of them?	1	2	3	4	5	V25
6.	Did the learners do anything constructive during the lesson?	1	2	3	4	5	V26
7.	Did the learners learn anything from this lesson?	1	2	3	4	5	V27
NB:	**Rating does as far as 5. Please ignore V14 to V27 when completing the form.**						
(e)	**LOGISTICS**						
1.	Were there enough desks for the learners?	1	2	3	4	5	V28
2.	Was there enough light in the classroom?	1	2	3	4	5	V29
3.	Were the media enough for the learners?	1	2	3	4	5	V30
4.	Was the lesson completed to the satisfaction of both the learners and the educator?	1	2	3	4	5	V31
NB:	**Rating goes as far as 5. Please ignore V21 to V31 when completing the form.**						

ANNEXURE "C"

Private Bag X2046
Mmabatho
2735

4th June 2001

The Respondent

.....

REQUEST TO COMPLETE A QUESTIONNAIRE

I, E.M. Seopo- Sengwe have registered with UNISA for D.Ed (Psy. Of Education) and am presently working on a study to determine and establish beyond doubt, the effect of media integration in the teaching of Mathematical concepts in the pre-primary and primary schools.

The aim is to determine the factors that influence the learners cognitive development and the criteria used for selection of media for teaching Mathematics.

I therefore request you to please spend a few minutes of your time to complete this questionnaire anonymously and return it to me within one week. Please use the enclosed envelope.

Your response will be handled confidentially. I appreciate your willingness to help me in this research effort. I believe you will find the questionnaire very interesting and provocative and I look forward to receiving your reply.

Enclosed please find the following:
(i) A Questionnaire
(ii) The instruction note
(iii) The stamped and addressed envelope

Thanking you in anticipation.

.....
E.M. SEOPO-SENGWE

Private Bag X2046
Mmabatho
2735

4th June 2001

The Principal
.....
.....
.....
.....

Sir/Madam

I E.M. SEOPO-SENGWE have registered with UNISA for D.Ed (Psy of Education). I am currently working on a study to determine and establish beyond doubt the effect of media integration in the teaching of Mathematical concepts in the pre-primary and primary schools.

The aim is to determine the factors that influence the learners' cognitive development and the criteria used for selection of media for teaching Mathematics.

I will appreciate it if I could be allowed to sit-in when the Mathematics lessons are being presented. Should my request be considered, I would like to meet the educators concerned so as to agree on the lesson topics and a suitable date for the presentation. One lesson from grade one and another lesson from grade four would suffice.

The lesson presentations will be followed by an interview of the educators concerned. The responses will be handled confidentially.

I, in anticipation, appreciate your willingness to help me in this research effort.

I am looking forward to a favourable response from your office.

Thanks

.....
E.M. SEOPO-SENGWE